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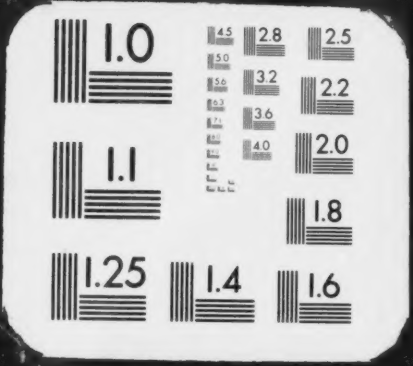
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PB80-150246

Northglenn Water Management Program
City of Northglenn, Colorado

Engineering-Science, Inc, Denver, CO

Prepared for

Environmental Protection Agency, Denver, CO Region VIII

11 Jan 80

United States
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Agency

Region 8
1860 Lincoln Street
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EPA 908/5-79-002A
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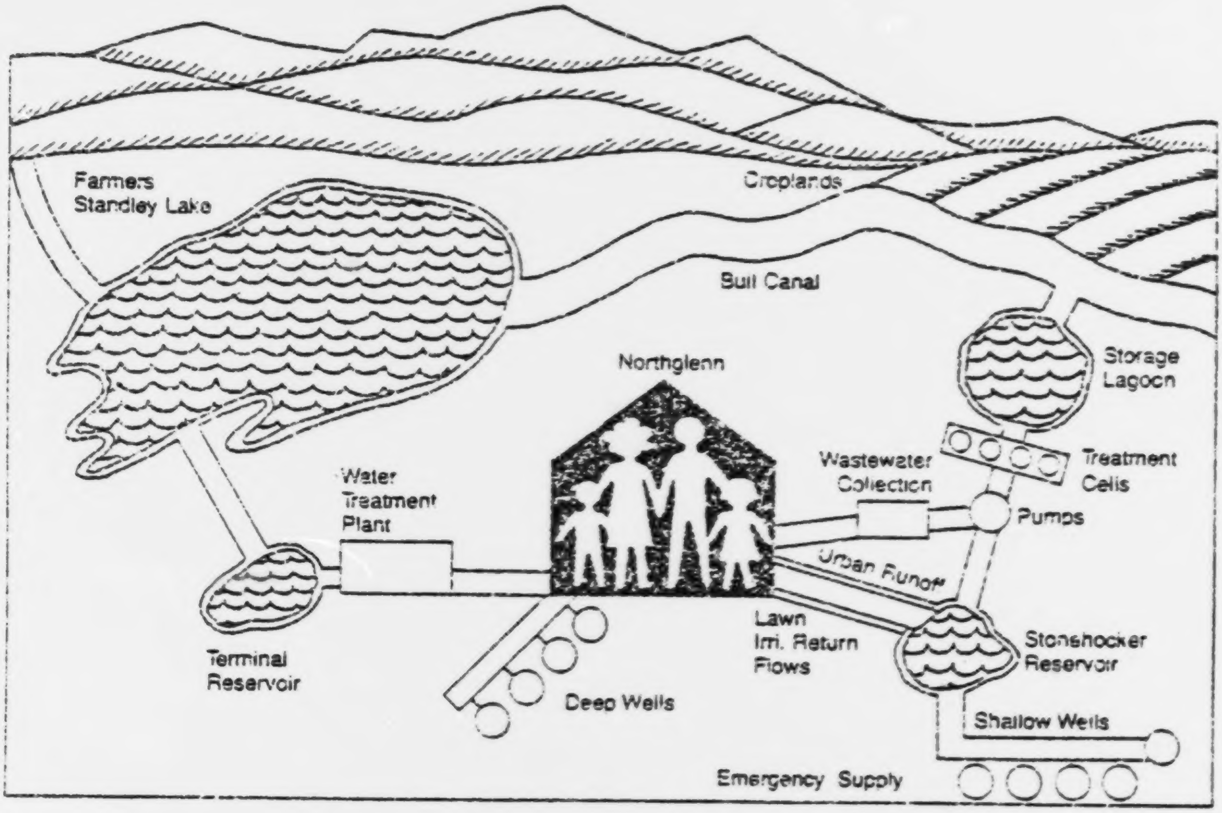
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Northglenn Water Management Program

City of Northglenn, Colorado

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A society which is clamouring for choice, which is filled with many articulate groups, each urging its own brand of salvation, its own variety of economic philosophy, will give each new generation no peace until all have chosen or gone under, unable to bear the conditions of choice.

Margaret Mead
Coming of Age in Samoa (1928)

TECHNICAL REPORT DATA

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1. REPORT NO. EPA-908/5-5-79-002A	2.	3. RECIPIENT'S ACCESSION NO. PB80 150246
4. TITLE AND SUBTITLE Draft Environmental Impact Statement Northglenn Water Management Program City of Northglenn, Colorado		5. REPORT DATE 6. PERFORMING ORGANIZATION CODE 8W-EE
7. AUTHOR(S) Weston W. Wilson and William Rothenmeyer, EPA Al Udin and Paul Seeley, Engineering Science, Inc.		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Engineering Science, Inc. 2785 North Speer Blvd., Suite 140 Denver, Colorado 80211		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency Region VIII 1860 Lincoln Street Denver, Colorado 80295		13. TYPE OF REPORT AND PERIOD COVERED 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

Environmental Appraisal and Negative Declaration dated September 29, 1978, also issued by EPA.

16. ABSTRACT

This is a draft Environmental Impact Statement (EIS) for proposed construction of facilities to provide water supply, wastewater treatment and agriculture reuse of sewage effluent for the City of Northglenn, Colorado. Under an exchange agreement with the Farmers Reservoir and Irrigation Company, approximately 5,000 acre-feet annually will be diverted forNorthglenn's municipal use, treated, augmented from other sources, stored, and then returned for irrigation purposes.

The U.S. Environmental Protection Agency (EPA), Region VIII, Denver, under the authority of Section 201 of the Federal Water Pollution Control Act Amendments of 1972, is authorized to grant 75 and up to 85 percent matching funds for construction costs of designated wastewater treatment facilities.

The recommended action is to construct an 8 mile interceptor, aerated lagoon and a storage reservoir. Implementation of the exchange program negates the pending water condemnation actions that were in progress.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Wastewater Reclamation Sewage Irrigation Agricultural Reuse Water Pollution Flow Augmentation Plan Alternative Wastewater Treatment Technology Environmental Impact Statement	Denver Regional EIS for wastewater facilities and the Clean Water Program Denver Metro Sewage Farmers Reservoir and Irrigation Company	

18. DISTRIBUTION STATEMENT Release Unlimited	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES
	20. SECURITY CLASS *(This page)*	22. PRICE

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

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DRAFT ENVIRONMENTAL IMPACT STATEMENT
NORTHGLENN WATER MANAGEMENT PROGRAM
CITY OF NORTHGLENN, COLORADO

Prepared by

U.S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado 80295

Approved by
Roger L. Williams
Regional Administrator

Date: JANUARY 11, 1980

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SUMMARY SHEET

DRAFT ENVIRONMENTAL IMPACT STATEMENT

NORTHGLENN WATER MANAGEMENT PROGRAM
CITY OF NORTHGLENN, COLORADO

Prepared by the U. S. Environmental Protection Agency, Rocky Mountain Prairie Region, Region VIII, Denver, Colorado, with assistance from Engineering Science, Inc. and Tipton and Kalmbach Engineers, consulting firms from Denver, Colorado.

A. Type of Action: (X) Draft EIS
( ) Final EIS

B. Brief Description of the Proposal

The Region VIII Administrator of the U. S. Environmental Protection Agency (EPA) intends to approve Federal matching funds for wastewater treatment facilities for the City of Northglenn, Colorado, through Title II of the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500), as amended in the Clean Water Act of 1977 (PL 95-217). Eligibility requirements and procedures necessary to qualify for a grant are set forth in 40 CFR, Part 35, Construction Grants for Wastewater Treatment Works. The Federal share shall be 75 percent of the total cost found to be eligible, with a portion of the facility being eligible for 85 percent Federal Assistance as "innovative or alternative wastewater treatment processes and techniques" referred to in Section 201(g)(5) of PL 95-217.

The purpose of this environmental impact statement is to present an evaluation of the environmental impacts of a plan submitted by Northglenn proposing to construct a multiple-purpose water resource project that includes a drinking water supply, wastewater collection and treatment system, an urban stormwater runoff collection system and an agricultural reuse program.

EPA issued an environmental appraisal/negative declaration on September 29, 1978 which analyzed the current plan but left unanswered critical questions on the impacts to agriculture and public health. Subsequently, Northglenn modified its plan to include purchase of agricultural rights from the South Platte River following denial by the State Engineer of permits for nontributary deep wells. EPA has decided to prepare this environmental impact statement in order to reevaluate the Northglenn plan with emphasis on the effects of the revised plan upon agriculture and possible health risks.

C. Lead Agency, Project Officer Contact and Address

The U. S. Environmental Protection Agency is the lead agency in a joint effort with the State of Colorado and the City of Northglenn, Colorado, to approve plans, necessary permits, and finance or award grants in order to implement this proposal. Mr. Weston Wilson, U. S. Environmental Protection Agency, Region VIII is the designated project officer.

Requests for free copies of this document should be addressed to:

Mr. Weston W. Wilson, Project Officer
U. S. Environmental Protection Agency
Region VIII
1860 Lincoln Street
Denver, Colorado 80295

or call (303) 837-4831.

D. Abstract of the Proposed Action

Northglenn has entered into a water exchange agreement with the Farmers Reservoir and Irrigation Company (FRICO) that allows Northglenn to borrow from FRICO up to 7,785 acre-feet per year of water stored in Standley Reservoir for municipal use. Northglenn is committed to return 110 percent of the water borrowed for municipal use to FRICO for agricultural use following wastewater treatment. The schematic depicted on the cover represents the components of this plan. In order to satisfy their pay back requirements of 110 percent, Northglenn proposes to construct a year-round storage reservoir in Weld County adjacent to their proposed wastewater treatment facility. The plan requires the development of a means of replacing the water borrowed by the City plus 10 percent. This augmentation plan for the water pay back includes a proposal to collect and treat urban stormwater, plans to acquire sufficient surface and shallow ground water supplies from the South Platte River and proposals to develop deep nontributary ground water. Additional surface water supplies have been acquired through the purchase of agricultural water rights.

E. Date filed with EPA and listed in the Federal Register:
January 11, 1980

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Northglenn Water Management Program
City of Northglenn, Colorado

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CHAPTER 1

SUMMARY AND PROPOSED EPA DECISION

The intellect of man is forced to
choose
Perfection of the life, or of
the work...
William B. Yeats
The Choice (1933)

Chapter 1

SUMMARY AND PROPOSED EPA DECISION

INTRODUCTION

Title II of the 1977 Clean Water Act established a program to provide Federal assistance in the development and implementation of wastewater treatment management plans and the construction of publically owned treatment works. Federal financing of wastewater treatment works is implemented in three steps: Step I, facilities plans, Step II, preparation of construction drawings and specifications, and Step III, construction of treatment works.

Northglenn funded Step I and Step II without Federal assistance. In September, 1977, Northglenn presented copies of their draft facility plan to EPA. The Plan was revised in November 1977 and again in March 1979. The State of Colorado Water Quality Control Division, in March 1978, certified to EPA Northglenn's application for funding. By regulation, EPA cannot award a grant until it has approved a facility plan for the proposed project and performed an analysis of the environmental impacts of the project under the National Environmental Policy Act. EPA issued an environmental appraisal/negative declaration on September 29, 1978 which analyzed the current plan but left unanswered critical questions on the impact to agriculture and public health. Subsequently, Northglenn modified its plan to include purchase of agriculture rights from the South Platte River following denial by the State Engineer of permits for nontributary deep wells.

DESCRIPTION OF THE PLAN

The City of Northglenn, Colorado is proposing to construct a multiple-purpose water resource project that consists of a drinking water supply, wastewater collection and treatment system, an urban stormwater runoff collection system and an agricultural reuse program. This integrated approach to water resource management is predicated on the following factors:

1) Northglenn's stated need to provide an adequate source of water for its users through the year 2000.

2) Northglenn's stated need for an improved water quality in its potable water supply. Northglenn currently is provided a water supply from the City of Thornton, Colorado. This water supply has, in the past, experienced concentrations of nitrite that exceed the National Drinking Water Standard.

3) The Farmers Reservoir and Irrigation Company (FRICO) can provide an adequate supply of acceptable quality water to

Northglenn and has demonstrated a willingness to participate in the proposed plan.

Northglenn has entered into a water exchange agreement with FRICO that allows Northglenn to borrow from FRICO up to 7,785 acre-feet per year of water stored in Standley Reservoir for municipal use. Northglenn is committed to return 110 percent of the water borrowed for municipal use to FRICO for agricultural use. To satisfy their pay back requirement of 110 percent, Northglenn proposes to construct a year-round storage reservoir in Weld County adjacent to its proposed wastewater treatment facility. The plan also requires the development of a means of replacing the water borrowed by the City plus 10 percent. This plan for the water pay back includes a proposal to collect and treat urban stormwater, plans to acquire sufficient surface and shallow ground water supplies from the South Platte, and proposals to develop deep nontributary ground water. Surface water supplies have been acquired through the purchase of agricultural water rights. As defined under the agreement between FRICO and Northglenn (see Appendix D), FRICO is free from any obligation to provide water to Northglenn until all necessary collection, storage, treatment, and transmission facilities are constructed and Northglenn has secured a decree from the Water Court that they have sufficient water to satisfy its obligations.

Presently Northglenn's wastewater is conveyed by the Thornton system and treated at the Denver Metropolitan Sewer District No. 1 (Denver Metro). This service is provided by Thornton through individual contracts that will expire by 1988 with each property owner in Northglenn. Consequently, Northglenn has negotiated an agreement with Thornton whereby Northglenn's wastewater treatment will be provided by Northglenn. Northglenn's revised facility plan (1) makes the following recommendations for wastewater transport, treatment, and disposal:

- Collection System - In accordance with the agreement reached with Thornton, Northglenn will make improvements to the existing collection system to redirect the wastewater flows to the new Northglenn facility (See Appendix D). These improvements include sealing off several lines and connecting them to a new interceptor which will convey the wastewater from the City of Northglenn to the proposed treatment site.

- Conveyance System - One interceptor is identified in the facility plan as needed to convey wastes from Northglenn and the small Thornton enclaves within the service area. The proposed Northglenn Force Main (46,900 feet) would carry sewage and augmentation water eight miles north of the City to the proposed plant site.

- Wastewater Treatment - The facility plan recommends an aerated, three cell lagoon system for treatment prior to storage and discharge.

- Storage and Disposal - The facility plan recommends a 4362 acre foot reservoir (Bull Canal Reservoir) to be constructed in Weld County to provide for winter storage of the effluent. The treatment and storage sites are located adjacent to the Bull Canal, approximately 1½ miles northeast of the intersection of Interstate Highway 25 and Colorado State Highway 7 in Weld County, Colorado. During the irrigation season, FRICO has the right to call for release of water stored in the reservoir. Consequently, the discharge rate will fluctuate based on the calls made on the reservoir. Chlorination of the effluent will occur just prior to discharge from the storage reservoir to the Bull Canal irrigation ditch.

- Sludge Disposal - The facility plan recommends that sludge be removed every five to ten years and be injected in the surrounding agricultural land.

Description of Options

Within the framework of the Plan four options dealing with water supply have been identified by Northglenn and EPA. Each of the first three options assumes that wastewater and urban storm runoff is conveyed and treated at the Weld County treatment site.

- Option 1 - Northglenn obtains South Platte surface water rights and does not obtain any additional nontributary groundwater beyond their existing decrees.

- Option 2 - Northglenn is awarded 650 acre-feet per year of nontributary ground water, thereby reducing the amount of FRICO borrowed water.

- Option 3 - Northglenn is awarded 2300 acre-feet per year of nontributary ground water further reducing the amount of FRICO borrowed water.

- Option 4 - An alternative to these plans is for Northglenn to acquire its future water supply requirements from FRICO by condemnation or purchase. Wastewater under this system would be conveyed to and treated at the Denver Metro plant with discharge to the South Platte River.

A more extensive discussion of the four options is presented in Chapter 4.

Five problems have been identified by EPA as key issues of this proposal. These issues are:

- public health

- agricultural productivity

- protection of potential drinking water supplies
- direct impacts of the wastewater treatment facility
- eligibility for EPA funding

PROPOSED EPA DECISION

The Northglenn proposal integrates total water resource management and includes such positive environmental features as agricultural reuse of effluent, energy efficiency, urban runoff controls and a water conservation policy. Therefore, EPA proposes to approve the Northglenn proposal and to make a grant offer, with conditions, in the amount of $6,948,000.

This proposed decision is based on an analysis of the following factors:

1) additional public health control measures beyond those originally proposed in the plan are required and will be implemented by Northglenn;

2) the project includes significant benefits to agriculture as compared to the situation if on-going water condemnation litigation had proven successful;

3) the Northglenn water rights applications, including change of water rights and the augmentation plan, are a logical approach to preventing injury to other vested water rights. There are a number of legal issues to be resolved by the Water Court and some changes to the water plan as filed are likely;

4) there are no significant direct adverse environmental effects of the proposal other than a potential odor problem at the treatment site;

5) assuming the Bull Canal is currently suitable as a domestic raw water source, if the proposal is implemented Bull Canal will no longer be suitable as a source of domestic raw water, due to nitrate concentrations. EPA concludes that since the Canal is not presently used for a domestic water supply, nor has there been any formal request to designate the canal for domestic water supply, there is no need to protect the canal for water supply;

6) the proposed wastewater system and agricultural reuse system is eligible for a grant providing partial funding as a multiple-purpose project using alternative technology as defined under the Clean Water Act.

Further detailed explanation of the analysis of these factors follows:

Need for Additional Public Health Control Measures

Based upon review of the medical literature, and EPA and Colorado policies, EPA concludes that additional measures to further protect public health are necessary. These measures, contained as grant conditions, include:

1. Chlorination prior to discharge to further reduce the concentration of fecal coliform bacteria to 200 fecal coliform organisms per 100 milliliters (ml).

   A permit criterion of 1000/100 ml was considered sufficient for agricultural use where some dilution of the effluent would occur. However, EPA and Northglenn have agreed to meet a criterion of 200/100 ml for the discharge into Bull Canal.

2. Prevention of agriculture tailwater runoff into the Towns of Frederick and Firestone.

   Present agricultural practices combined with a lack of proper storm water drainage allows runoff to flow through these communities. Northglenn will be required, at their expense, to intercept and control these flows in order to further reduce public contact with tailwater runoff (treated sewage effluent).

3. Complete disinfection of Dacono's nonpotable irrigation system.

   The Town of Dacono operates a nonpotable water system used for lawn and garden irrigation. The source of this water is Bull Canal which will, on occasion, consist entirely of treated sewage effluent from Northglenn. In order to minimize the potential for disease transmission in this situation, Northglenn is required, at their expense, to disinfect or replace this source of nonpotable water.

4. Prevention of sale of raw edible crops grown under the Standley Lake Division of FRICO.

   In order to receive a grant from EPA, Northglenn will have to agree to a plan to prevent the public sale or distribution of raw edible food crops irrigated with effluent from the Northglenn plant. Northglenn will assist farmers in marketing the crops to buyers that will process the crops or Northglenn will otherwise compensate the farmers for economic losses to the extent of actually purchasing the vegetables if no other satisfactory solution can be found. This condition is necessary in order to minimize the possibility of disease transmission through ingestion of contaminated vegetables. Northglenn will also issue and reissue an advisory that will inform farmers

and discourage direct contact with the water
and its use on private gardens.

See Chapter 5 for a complete description of these conditions.

Benefits to Agricultural Productivity

EPA analyzed the Northglenn water exchange plan for possible adverse economic and water quality effects upon agriculture. As originally proposed, the exchange plan included deep wells as the entire source of make-up waters. With development of such a new water source it was obvious that there would be a benefit to agricluture because of this new supply. Following denial by the State Engineer of the necessary well permits for these nontributary waters, Northglenn purchased South Platte surface water, some of which is currently used for agriculture, for their make-up water supply. Under the latter scheme, it was unclear if indeed there would be any agriculture benefits to the proposal. EPA decided that further study of the possible economic impact upon agriculture was necessary.

The results of EPA's economic analysis indicate that if no additional deep wells are permitted, (currently on appeal by Northglenn) a decrease in agricultural productivity of up to $460,000 during a dry year could occur along the South Platte River. However, this is more than compensated by continued agricultural production in the FRICO system of $1,180,000 in a similar dry year. Compared to either direct purchase or successful condemnation of the FRICO water supply, the proposed Northglenn exchange plan is beneficial to the agricultural community. Further, EPA concludes that properly managed, the benefit of the nutrient values in the sewage effluent will be a net asset which will enhance agriculture production in the area at reduced costs.

Under the Colorado Constitution which recognizes domestic preference, the condemnation proceedings against the FRICO water supply would likely be successful. Therefore EPA supports the proposed exchange as being consistent with EPA policy to protect environmentally significant agricultural lands. (Chapters 3 and 4 provide further analysis.)

There are also possible adverse impacts to agriculture with respect to the changes in water quality created by the return of treated sewage effluent to the Bull Canal. Possible adverse effects include:

- reduction in sugar beet purity

- reduction in barley starch content

EPA concludes that through proper management, such as reduction of nitrogen fertilizer applications and proper scheduling of sewage effluent and Standley Lake releases, these possible problems can be eliminated.

Protection of Vested Water Rights

Northglenn must receive approval of the Water Court for a plan of augmentation in order to implement its proposal. In addition, Northglenn has purchased various water rights and intends to transfer such water. This shift in usage of the water in the over-appropriated South Platte system must comply with Colorado's Water Law and receive approval by the State Water Court.

EPA concludes, based upon expert opinion, that 1) other complex plans with similar principles have been approved by the Water Court and this plan can be administered by the State Engineer; 2) the amount of water obtained from surface sources is reasonable based on historic ditch diversions and stream depletions; 3) the exchange plan will sufficiently protect FRICO shareholders; 4) through the Water Court process, out-of-priority diversions will be properly augmented; 5) the water rights to be used for augmentation are sufficiently senior for that purpose; 6) South Platte water users will be compensated for additional ditch losses.

In analyzing the water rights and augmentation plans of the Northglenn project, a number of legal issues have been identified by EPA.

These legal issues will be resolved through the judicial process if necessary. EPA concludes that some changes to the water plans as filed are likely but the probable effect of any subsequent changes during the court process will likely be limited to requirements for additional water for augmenting purposes.

Direct Effects of the Proposal are Not Significant

EPA's conclusion as to the significance and impacts of direct adverse impacts is:

- Loss of tax base - The projected loss of $8,500 annually to Weld County and $300 annually to Adams County is a small decrease in net tax revenues to the two counties.

- Effect on Adjacent Land Values - A decrease in adjacent residential values up to five percent is possible with no change in farmland values.

- Ground water pollution - The proposed clay liner of the reservoir and lagoon system will minimize any change in ground water quality. Additional construction measures are required by EPA to properly seal a non-active fault if present. No adverse impact upon ground water is predicted.

- Odor problems - Under "worst case" conditions which include malfunction of the aeration system, the Colorado State Standard for odor could potentially be violated up to 2.5 miles from the facility. Noticeable increases in odor could result.

- Reservoir Dam Safety - The design standards meet those recommended by the U. S. Bureau of Reclamation, U. S. Army Corps of Engineers and have been approved by the Colorado State Engineer. No unusual risks are apparent.

- Aesthetics - The storage reservoir embankment will be revegetated and will have a low profile. Therefore, it should not adversely affect the aesthetics of the area.

(See Chapter 4 for additional analysis of these effects and other indirect effects.)

Protection for Drinking Water Supplies is Not Necessary

The Bull Canal is not currently used for a domestic water supply and there has not been any petition to the State to designate this source for domestic use. Based on very limited data, it does appear the Bull Canal is currently suitable for a domestic raw water supply. The Town of Frederick indicated to EPA they intended to use water from the Bull Canal to augment their present surface supplies. The Town of Ft. Lupton has informed EPA of its intention to use Sand Hill Reservoir which receives some flow from Bull Canal as their future domestic water supply source.

The concentration of nitrates in the canal could adversely affect such plans since the concentration will exceed the National Drinking Water Standard of 10 mg/1. Water containing such high concentrations of nitrates is not economically suited as a domestic source. EPA recognizes that this change in water quality potentially represents a resource lost. EPA concludes that: 1) Bull Canal discharges to Sand Hill Reservoir are insignificant to the total inflow and, therefore, this proposal should not adversely affect Ft. Lupton's intended use of this source and 2) the Town of Frederick should seek other available sources for a domestic supply.

The Proposal Qualifies for EPA Funding

EPA is presently in the process of developing a method for funding multiple-purpose projects which involve innovative and alternative technology in order to apply the incentives provided by the 1977 Clean Water Act Amendments. EPA has determined that such projects are eligible for grant awards based on a formula of 115 percent of the ratio of the present worth cost of the most cost-effective single-purpose option, to the present worth cost of the multiple-purpose project. This formula calculates the fraction of the multiple-purpose project costs which are eligible for EPA funding. Portions of a multiple-purpose project which involve innovative or alternative technology are eligible for an 85 percent grant rather than the normal 75 percent grant. Agricultural reuse of effluent is defined in the Act as an alternative technology. The total grant amount is therefore determined by multiplying the fraction of the multiple-purpose project costs that are eligible times 85 percent for those items necessary for agricultural reuse and 75 percent for all other wastewater elements.

For EPA to participate in the funding of a multiple-purpose project, the following rules apply. The Northglenn proposal meets these requirements:

1. The cost of the multiple-purpose project must not exceed the sum of the costs of the most cost-effective single-purpose options which accomplish the same purposes. (The Northglenn proposal combines wastewater treatment with agricultural reuse less expensively than two single purpose projects providing similar functions.)

2. The primary and secondary environmental effects are assessed in accordance with the NEPA review procedures. (As a result of this review under NEPA, EPA concludes that there are no significant net adverse environmental impacts and that net environmental benefits will result from this project.)

3. The pollution control purpose of the proposed project must be necessary to meet an enforceable requirement of the Act. (Additional costs associated with wastewater treatment are necessary for Northglenn during the 20 year planning period to meet enforceable requirements of the Act as defined in Denver Metro's discharge permit. These costs include the need to expand conveyance facilities and to expand and upgrade the Denver Metro Plant.)

4. There is no purchase of existing facilities with federal funds. (Northglenn's purchase of existing water distribution and collection systems has been eliminated from grant eligibility.)

5. The project meets the definition of treatment works, and the works are publicly owned. (The wastewater treatment project and all features of the Northglenn project will be publicly owned.)

6. The project is consistent with the adopted and approved water-quality management plan. (EPA has determined that the Northglenn proposal is in compliance with the Denver Regional Council of Governments (DRCOG) Clean Water Plan. Adoption of an Intergovernmental Agreement with Weld County as required by EPA as a prerequisite to final grant payment will mean the project is also in compliance with the Larimer-Weld Council of Governments Clean Water Plan.)

7. The applicant must demonstrate a commitment that effluent will be applied to irrigated productive agricultural land for the design life of the project. (Northglenn has committed to a contingency plan where they will maintain sufficient land to reuse all water generated by the treatment plant for agricultural irrigation for the design life of the plant.)

CHAPTER 2

PURPOSE AND NEED

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To every thing there is a season, and
a time to every purpose under the heaven.
The Bible
Ecclesiastes 3:1

CHAPTER 2

PURPOSE AND NEED

The City of Northglenn is located in a rapidly growing area north of Denver, Colorado. Northglenn is largely developed and surrounded by other incorporated communities. The 1976 population for Northglenn was 32,000 people in 9,500 residential units. There are 10,000 connections to the water system within the City to serve commercial, industrial, public, and residential users. The future population of Northglenn is projected to be 42,500 by 2000 with an ultimate population expected to be as high as 48,000. Annual rate of growth is expected to be 3.1 percent per year.

Until recently, the City of Thornton owned the water transmission and sewage collection systems in Northglenn. Thornton was responsible for operation and maintenance, billing of customers, construction of new lines and all other functions related to the total water and sewerage system.

Future water supply requirements of Northglenn have been estimated for a year of average precipitation and a dry year based on an expected population of 42,500 people. Based on this design population, the average and dry year water requirements of Northglenn are 6,840 acre-feet and 7,340 acre-feet of water, respectively.

Northglenn's stated position is that the City of Thornton can not provide an acceptable water supply, either in terms of quantity or quality. The raw water quality at Thornton's Columbine Water Treatment Plant has on occasion had nitrite concentrations that exceed the drinking water standard of 1.0 mg/l (1). Thornton indicates this problem has been corrected (2). Thornton also indicates that they are currently developing water resources outside of the Denver metropolitan area to supplement their existing water supplies. The current position of Thornton is that they can provide an adequate water supply for themselves and Northglenn (3).

The need to acquire additional water supplies for future growth in Thornton, Westminster, and Northglenn resulted in several events which began in 1963. These actions are presented chronologically below:

- 1963 - Westminster entered into agreement with FRICO for use and storage of water in Standley Lake.

- 1973 - Thornton files condemnation proceedings against individual FRICO farmers.

- 1973 - Westminster files condemnation proceedings against FRICO farmers.

- 1976 - Northglenn enters into an exchange agreement with FRICO.

- 1979 - Northglenn and Thornton enter into severance agreement of water and sewer services.
- 1979 - Northglenn, Thornton, Westminster and FRICO enter into a four-way agreement which establishes an approach to cooperative planning for solving water supply problems, and facilitates the withdrawal of all condemnation suits against FRICO farmers.

The documents are presented in Appendix D of this report.

By obtaining water from FRICO, Northglenn has assured itself of water of adequate quality and a certain water supply source for the future. The City has also obtained utility independence through purchase of its water and sewer systems. In the process of entering into agreements to insure its future water supply, Northglenn made the commitment to return 110 percent of the water borrowed from FRICO. To achieve this water balance in the FRICO-Standley Lake Division, Northglenn intends to return its treated wastewater as part of its commitment to FRICO. The City must therefore, have access to the use and control of its wastewater. In order to accomplish this Northglenn must "sever" its dependence on Denver Metro for sewage treatment. As required by the September 2, 1976 agreement between Northglenn and FRICO, Northglenn must "collect the water (after municipal use), treat it in accordance with FRICO's specifications, store it and transmit it back to the FRICO irrigation network for delivery to FRICO stockholders". (4)

The agreements previously discussed are vital steps toward full implementation of Northglenn's current water resource management plan. Equally important steps such as Water Court approval of the plan of augmentation remain to be taken before the plan is fully implemented. If all obstacles are not overcome, then Northglenn will have to modify its current plan or use another approach to secure a safe, dependable source of supply. Failure to implement the current plan would also affect the plans of Thornton and Westminster, possibly resulting in these cities refiling condemnation proceedings against FRICO. The success of those proceedings could force Northglenn to secure other sources of irrigation water, nontributary ground water, tributary ground water, or combinations thereof. The environmental consequences of such a chain of events can not be fully determined, and may be of lesser or greater magnitude than those resulting from the full implementation of Northglenn's current resource plan.

In effect Northglenn's wastewater treatment need is entirely a function of the water supply and exchange program. In order to implement the exchange, control of wastewater treatment and discharge is essential.

CHAPTER 3

SIGNIFICANT ENVIRONMENTAL ISSUES

"Mere parsimony is not economy.
...Expense, and great expense,
may be an essential part of
true economy."
Edmund Burke
Letter to a Noble Lord (1796)

CHAPTER 3

SIGNIFICANT ENVIRONMENTAL ISSUES

INTRODUCTION

The significant issues of the Northglenn water resource management plan are how the future water quality and quantity will affect public health, possible drinking water supplies, and agricultural productivity. Other environmental issues associated with specific elements of the proposed plan include wastewater treatment site selection and other direct and indirect impacts of the treatment plant and are discussed in the next chapter on evaluation of alternatives.

In the future, water in the Bull Canal will consist of Standley Lake water and Northglenn wastewater effluent. The quality will vary depending upon the relative amount of each type. Using the projected effluent quality (1,2), Bull Canal water quality at the reservoir site and the relative Standley Lake flows for each option, future water quality in the Bull Canal below the discharge was calculated. A comparison of the water quality of the three options is presented in Table 3-1.

PUBLIC HEALTH

Potential health risks associated with uncontrolled use of wastewater conveyed through irrigation canals are:

- direct human contact with wastewater which has received little or no dilution
- human consumption of raw edible crops irrigated with wastewater

The specific risks within the Study Area are:

- public exposure/potential contact with effluent in the Bull Canal and lateral ditches
- contact by FRICO farmers with effluent through irrigation practices
- public exposure/contact with effluent at Dacono through their public irrigation system
- public exposure/contact with effluent as irrigation tailwater in the communities of Frederick and Firestone
- ingestion of raw food crops irrigated with effluent on FRICO farms
- raw edible food crops irrigated with effluent offered for public sale (none presently grown in FRICO-Standley Lake Division).

TABLE 3-1

COMPARISON OF FUTURE WATER QUALITY

	Proposed Discharge Effluent[1,2] Quality	Projected Water Quality in Bull Canal AVERAGE YEAR[3]		
		Option 1	Option 2	Option 3
Total Dissolved Solids mg/l	450-500	410-440	400-430	400-430
Suspended Solids mg/l	20-30	190-200	220-230	24 -245
BOD mg/l	10	8	8	8
Fecal Coliform #/100 ml	200	170	160	160
Cadmium mg/l	0.005	.007	.007	.007
Chromium mg/l	0.005	.007	.007	.007
Copper mg/l	0.05	.07	.07	.07
Lead mg/l	0.005	.007	.007	.007
Manganese mg/l	0.05	.14	.16	.16
Mercury mg/l	0.001	.001	.001	.001
Zinc mg/l	0.30	.23	.21	.21
Sodium mg/l	30-40	30-40	30-40	30-40
Sulfate mg/l	100-120	90-100	90-100	90-100
Chloride mg/l	25-35	20-27	19-25	18-24
Nitrate nitrogen mg/l	20	14	12	12

1-Volume 3, Sheaffer and Roland, Wastewater Facilities Northglenn, Colorado April 25, 1977.

2-Volume 4, Sheaffer and Roland, 201 Wastewater Facilities Plan, August 24, 1977.

3-Dry Year conditions for all options assumed to be 100 percent effluent below discharge. Therefore, water quality in the canal would be the same as the effluent quality during such dry years.

Coliform bacteria are the commonly used indicator organisms for assessing public health risks associated with waterborne disease. Fecal coliform, bacteria common to warm-blooded animals, are recognized as positive indicators of potential health risks. The potential for isolating a specific pathogen per unit volume in 100 percent effluent is significantly higher than when the same effluent has been volumetrically diluted. It is therefore apparent that with 100 percent effluent the potential for infection is greater than with a diluted effluent. The fecal coliform analysis however, does not differentiate specific pathogens.

During dry year conditions flow in the Bull Canal may be entirely sewage effluent, thus increasing the public health risk. The State of Colorado provides minimal guidance on this problem in their proposed water quailty criteria and standards (3).

The draft water quality standards proposed by the State include a standard for agriculture for a fecal coliform limit of 1000 organisms per 100 milliliters (ml). This value was based on the recommended criteria presented in the National Academy of Science (NAS) report (4). The value of 1000 organisms per 100 ml is based on an ambient instream condition and is not based on a condition of 100 percent wastewater. In Colorado's final proposed water quality standards (3) the 1000 organisms/100 ml has been omitted for agriculture. The State's current fecal coliform water quailty criteria are presented in Table 3-2.

The State separates recreational waters into two classes. Class I recreation is primary contact and Class II is secondary contact. The Report of the Committee on Water Quality Criteria (5) specifies that the primary contact (Class I) category includes such activities as wading and dabbling by children, swimming, diving, water skiing, and surfing; where there is a relatively high probability of ingesting small quantities of water and where there is contact with mucous membranes. Secondary contact (Class II) includes activities in which contact with the water is either incidental or accidental and the probability of ingesting appreciable quantities of water is minimal. These include such activities as boating and fishing.

The Class I recreational criterion is based on data which indicate a sharp increase in the frequency of detection of Salmonella when fecal coliform densities exceed 200 organisms per 100 ml in fresh water. Currently, this is one of the most acceptable relationships which have been developed between indicator organisms and waterborne pathogens. This relationship is based on an instream condition and not 100 percent effluent (4).

Public Health Risks and Irrigation with Northglenn Effluent

The reuse of wastewater, when out of control of the municipality, should provide for the protection of the public health both during agricultural uses and public exposure. A review of the medical literature regarding such risks is presented in Appendix B.

In a dry year, irrigation water in the Bull Canal below the

TABLE 3-2

COLORADO PROPOSED CRITERIA FOR FECAL COLIFORM*

Parameter	Use Recreation Class I	 Class II	Water Supply	Agriculture
Fecal Coliform, #/100 ml	200(A)	2000(B,C)	2000 (D)	no standard(E)

*Department of Health cites the following references as noted as justifications for criteria limits.

A. EPA, Quality Criteria for Water, July 1976, U. S. Environmental Protection Agency, U. S. Government Printing Office: 055-001-01049-4, Washington, D.C. 256p.

B. Recommendations based on review of all available information by the Committee on Water Quality Standards and Stream Classification.

C. Level modified by Water Quality Control Commission.

D. EPA - National Interim Primary Drinking Water Regulations, 40 Code of Federal Regulations, Part 141.

E. Colorado State Water Quality Standards included a standard of 1000/100 ml for agriculture but this standard has been dropped. EPA's Quality Criteria for Water does not specify a fecal coliform criteria for agricultural use.

Northglenn discharge will consist of 100 percent effluent with no dilution. It can be concluded from the literature review (in Appendix B) that public health risks associated with effluent reuse must be considered on a case-by-case basis. EPA, in its process design manual for Land Treatment of Municipal Wastewater endorses this approach by stating, "Safeguards must be established on a case-by-case basis so that the relative risk of disease transmission in each situation can be evaluated individually" (6).

Guidance for reasonable health safeguards for effluent irrigation systems in which public exposure is not controlled is provided from EPA and the Colorado Department of Health. EPA, in PRM 79-3 (7), recommends for areas where the public has access and exposure to the wastewater, that the fecal coliform limit should not exceed 200/100 ml. The Colorado Department of Health (8) guidelines for landscape irrigation, because direct contact with wastewater by the public is possible, also require that chlorination result in less than 200 fecal coliforms per 100 ml. The State guidelines also indicate crops grown under these conditions shall not be raw edible vegetables (8).

These values are not as conservative as the California Code or the World Health Organization criterion of 2.2/100 ml (total coliform) and 100/100 ml (total coliform), respectively. The Food and Drug Administration currently recommends that raw edible food crops not be irrigated with domestic wastewater irrespective of the degree of treatment.

Data on public health risks relative to irrigation with wastewater are conflicting and are reflected in the lack of uniform requirements or standards covering such use. The data on public health hazards associated with uncontrolled access/use of treated wastewater are virtually nonexistent. EPA believes the proposed Colorado primary contact recreational bacteriologic standard of 200 fecal coliform organisms per 100 ml is a reasonable bacteriological criterion for discharge of the treated Northglenn wastewater to the FRICO system. This standard would be compatible with unrestricted public access to the FRICO canal system (1). The proposed bacteriological discharge level of the Northglenn effluent (1,2) will provide a relatively high level of pathogen control, but the presence of some pathogenic organisms in the irrigation water can be expected. Therefore, EPA has required that prior to discharge chlorination achieve a level of less than 200 fecal colonies per 100 milliliters (Chapter 5 includes this condition).

Heavy Metals and Industrial Pretreatment Requirements

Heavy metals present in wastewater are generally concentrated in wastewater sludges. Major heavy metals of concern to the food chain include, cadmium, copper, zinc, molybdenum, selenium, and lead. All of these are of sufficiently low concentrations in the natural soils and the projected wastewater effluent that they are not expected to produce an adverse impact. Soils with high clay content also protect against the availability of metals for plant uptake. For most toxic metals, reduced crop yields are experienced at lower levels than those that create health risks.

A likely source of heavy metals in the wastewater system will be from industrial sources. A condition to obtaining construction grant funds is that the applicant implement a sewer use and pretreatment ordinance. Northglenn must have such an ordinance approved prior to the construction grant prepared for the new treatment facility. A portion of Thornton will also be served by Northglenn and this area will require a similar ordinance as required by the May 4, 1979, Northglenn-Thornton agreement (9). (Reprinted in Appendix D.)

The purpose of a sewer use ordinance is to prevent discharge of materials into sewer lines which would create a discharge violation or make treatment unreasonably costly. A list of these materials, critical concentrations, and treatment requirements will be delineated in the sewer ordinance.

Although the City of Northglenn is comprised largely of residential units, there are some commercial and industrial facilities which potentially may discharge harmful wastes. A list of dischargers in the Northglenn service area is given in Table 3-3. A review of these facilities in Northglenn indicates that car washes and laundries are the predominant potential sources of industrial waste. An evaluation of these wastes on a case-by-case basis is necessary to determine if pretreatment is warranted. The proposed EPA treatment and control technologies for such facilities are:

- Dissolved air floatation,
- Coagulation/Settling/Filtration,
- Water Recycling, or
- Polishing Filters - Multi-Media and Carbon

The Thornton areas served by Northglenn are indicated in Figure 3-1. A review of zoning ordinances indicates that the majority of these areas are classified as commercial and industrial, with minor sections classified as residential development. As in Northglenn, laundries are the major industrial dischargers in Thornton.

Based on review of existing and proposed development it is concluded that industrial wastes are and will be a very small component of the wastewater from the Northglenn service area. The wastewater from the potential industrial and commercial establishments should be evaluated but it is unlikely that it will significantly affect the operation of the treatment facility, the effluent quality, or adversely effect sludge disposal. EPA concludes that the expected heavy metal concentrations in the effluent and sludge will not present any significant health risk.

TABLE 3-3

POTENTIAL INDUSTRIAL DISCHARGERS
IN NORTHGLENN SERVICE AREA

Discharger	Description
NORTHGLENN	
. Whistle Stop Exxon	Service Station w/car wash
. Huron Texaco	Service Station w/car wash
. Robinson's Standard	Service Station w/car wash
. North Washington Conoco	Service Station w/car wash
. Clean-o-mat	Laundromat
. Silver State Cleaners	Dry Cleaners
. Silver State Cleaners and Laundry	Dry Cleaners and laundromat
. Robo of Northglenn	Car wash
THORNTON	
. Triple A Coin Op	Laundromat
. Gigantic Cleaners	Laundromat

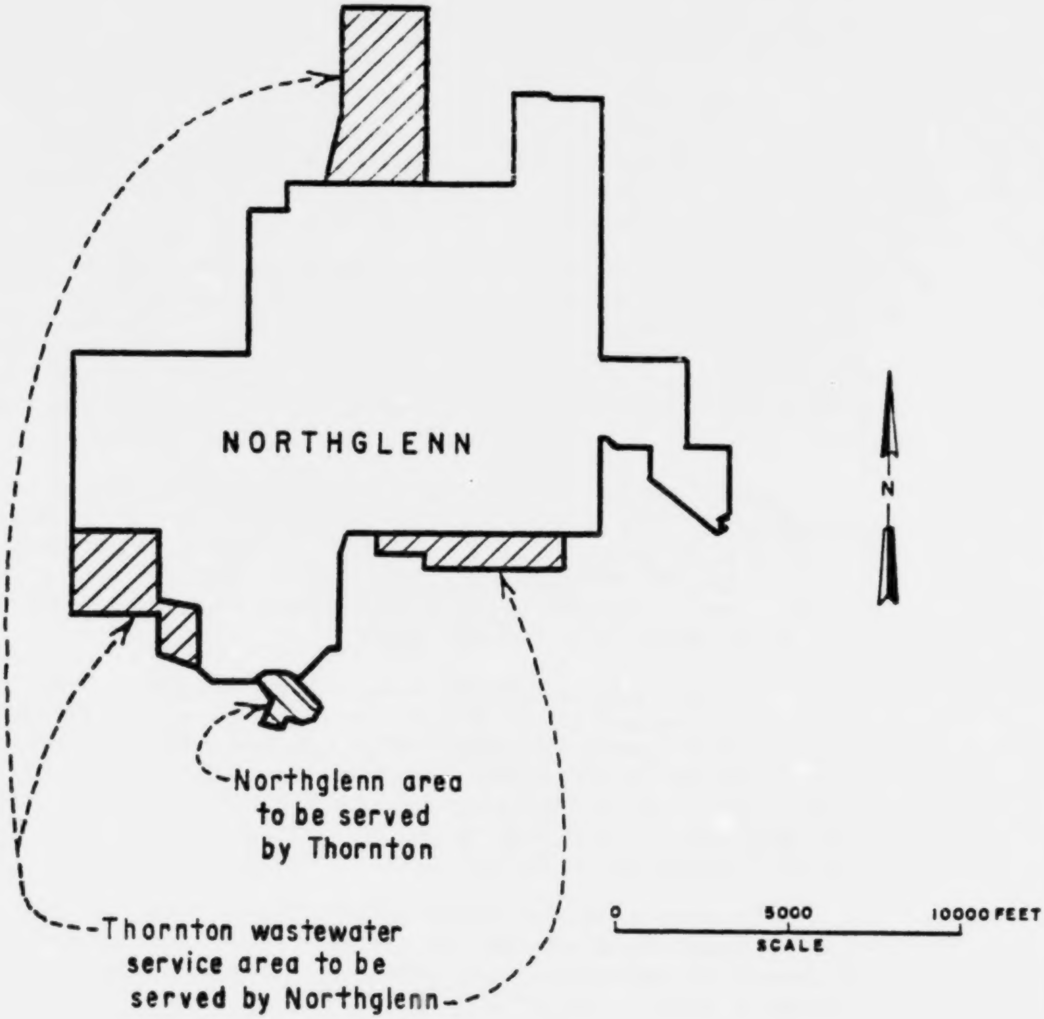

NORTHGLENN
N
Northglenn area to be served by Thornton
Thornton wastewater service area to be served by Northglenn
0
5000
10000 FEET
SCALE

FIGURE 3-1

THORNTON ENCLAVES TO BE SERVED BY NORTHGLENN

AGRICULTURAL ISSUES

EPA has established policy designed to help protect environmentally significant agricultural lands (10). The policy is to protect significant agricultural land from irreversible conversion to uses which result in its loss as an environmental or essential food production resource.

The Northglenn plan is designed to provide a net benefit to agricultural productivity. All elements of the plan, water supply, wastewater treatment, and reuse, are closely integrated with agricultural practices of both the South Platte River and FRICO-Standley Lake Division.

It is a major goal of this document to determine if the proposed plan is consistent with EPA's agricultural policy. The determination of consistency will be based on a comparative review of changes in agricultural productivity in FRICO and the South Platte for the options evaluated. Also evaluated will be the effect upon agriculture of the comparative changes in irrigation water quality in the Bull Canal for the various options.

The projected future water quality of the Bull Canal has been described. It is recognized that the increase in nitrogen can be beneficial to nitrogen demanding crops. However, sugar beet and malt barley are nitrogen sensitive crops. Nitrogen uptake by sugar beets is approximately 80 pounds per acre, and the barley uptake is about 75 pounds per acre.

When nitrogen deliveries exceed nitrogen uptake demand of sugar beets, a reduction of the percent sucrose content and purity occurs. This reduces the marketability and/or market value of the crop. Great Western Sugar Company in its contract with growers specifies that after July 15 the growers are prohibited from further nitrogen application. This provision assures that sugar beets will meet specifications for effective sugar recovery.

Nitrogen uptake by barley affects the protein and starch content. Again, marketability is reduced and entire shipments may be rejected by the processor if excessive nitrogen applications have severely reduced the starch content.

WATER SUPPLY TO AGRICULTURE

Analysis of the Northglenn water plan has indicated a number of potential issues which could affect the operation of the plan and/or the amount of augmentation water ultimately required by the City.

Nontributary Ground Water

Nontributary ground water (water that is not connected with the surface stream system) is available within the underlying aquifers of the City of Northglenn in the Arapahoe and Laramie-Fox

Hills formations. Northglenn has one well, Arapahoe Well No. 7, completed into the Arapahoe formation which is estimated to yield a small supply of 5 acre-feet per year. Information provided by Northglenn's engineers, Wright Water Engineers, Inc., based on a report prepared by John Romero of the State Engineer's Office, indicates that an additional amount of ground water might be available to provide 2300 acre-feet per year for a minimum of 100 years (11). Mr. Romero's study generally encompassed a wide area and additional site specific testing would have to be accomplished to verify this amount of water is available to Northglenn. The Arapahoe Aquifer is estimated to yield 1300 acre-feet per year and the Laramie-Fox Hills is estimated to yield 1,000 acre-feet per year for a minimum of 100 years. The effect of either of these aquifers failure to yield that amount will require Northglenn to borrow more from FRICO or aquire other surface waters.

Tributary Ground Water

Part of Northglenn's plan includes obtaining some makeup water from a tributary well field along the South Platte River. The design of the well field has not been completed. One area identified as a potential site was found unsuitable and additional investigations are currently underway by Northglenn's consultants. Since under current plans, this well field is not intended to be a major water source, continuous pumping for long periods of time is unlikely. It is improbable the well field will have a noticeable impact on agriculture. In the event ground water levels were lowered through operation of the well field on a permanent basis, there could be negative impacts. The final evaluation of the impacts of the well field cannot be completed until the field is located and the wells are designed.

Standley Lake Yield

In the period 1941 through 1976 the average yield to the farmer from the Standley Lake system was 4.9 acre-feet per share. The lowest yield was 1.3 acre-feet per share in 1955 (12). According to a study by Blatchley and Associates, the amount of delivered water in 1932 was about 0.80 acre feet per share, the lowest on record (13). In contrast, Northglenn has projected a future dry year yield of 5 acre-feet per share with an average yield of 7 acre-feet per share. This estimate is predicated on a number of assumptions:

1. The Bull Canal system will be lined, reducing the ditch loss from an historical average of 40 percent to about 10 percent in the future.

2. Losses in Big Dry Creek which historically have been between three and five percent (14) will be zero in the future and there may be an increase due to urbanization of the area adjacent to Big Dry Creek, which would increase runoff yields.

3. The Cities of Northglenn, Westminster and Thornton now own approximately 39% of FRICO's share and will take their water directly from Standley Lake (15). This increase in city ownership reduces losses associated with agricultural use.

4. There is a better prediction of dry year yields based on improved snowpack estimates. This will result in a more efficiently managed water supply.

5. Previous studies have apparently been based on potentially erroneous data relative to the Croke Canal (a feeder canal from Clear Creek to Standley Lake). Revised studies by Northglenn's consultants have been based upon the change in reservoir water levels.

6. The reservoir was enlarged in 1965, and the larger volume will allow more efficient water use. In the dry year of 1977, which can be compared to 1954 -- the driest on record since 1941--the unit release was 5.9 acre-feet per share (16).

For the analysis of the Northglenn water management study, the yields of 5 and 7 acre-feet per share for dry and normal years is considered reasonable by EPA. This will also be approximately equal to the yield to the farmers because of lining of the Bull Canal system and the 10 percent bonus provision in the Northglenn/FRICO agreement. In the event the Bull Canal system is not lined, a yield of 5 acre-feet per share at the reservoir will be about 3 acre-feet per share delivered to the farm headgate.

One consideration which may reduce or have a negative impact on the yield of Standley Lake in the future is that the Croke Canal is the primary supply to Standley Lake and, with a 1902 appropriation date, is a relatively junior water right on Clear Creek. The Croke Canal generally is in priority only during winter and spring runoff periods. Because of increased efficiency in water use by other senior appropriators within the Clear Creek and South Platte River Basin, concern has been expressed that the yield of the Croke Canal may continue to diminish (14).

Bull Canal Water Distribution

Through the Northglenn/FRICO water exchange plan, payback water will be returned to the Bull Canal at the Bull Canal Reservoir site approximately 13 miles from the headgate of the Bull Canal. In 1979, there were 401 farmer shares upstream of the point of payback return and 1049 farmer shares downstream (17). Under certain flow conditions with some of the options considered, there is not sufficient water available in Big Dry Creek at the headgate of the Bull Canal to give the upstream shareholders the same yield as those downstream of the point of return. In a mutual ditch company, the share yield throughout the system is supposed to be equal. Northglenn has stated, although no provision is made in any of the agreements or within the augmentation plan, that if such a shortage occurs, they will make water available either from holdover storage in Standley Lake, by pumping to the upper shareholders from the Bull Canal Reservoir, or by other means to insure the same yield upstream as downstream of the point of return.

PLAN FOR AUGMENTATION AND CHANGE OF WATER RIGHTS

The contract between Northglenn and FRICO and the water rights owned by Northglenn provide a physical water supply to the City. In addition to the physical supply, it is necessary to insure there is a legal right for the City to use the water. Because the South Platte Basin is overappropriated, application to the Water Court for a new municipal water right for Northglenn would not provide any water on a legal basis except during certain limited times of the year when free water would be available.

The Northglenn water plan has three essential components in terms of providing Northglenn a legal water supply. These are as follows:

a. Change in water rights.

b. Plan for augmentation.

c. New water rights.

A copy of the change in water rights and the plan for augmentation is included in Appendix D. Northglenn has filed a number of new water rights which form a part of the plan for augmentation. The filing for nontributary ground water from beneath the city is pending with the Water Court.

The change of water right filing for the Northglenn Plan involves changing the decrees of the Church Ditch, Farmers High Line Canal, East Lake Water Company (carried in and served by the Farmers High Line Canal) and the Berthoud Pass Ditch.

The plan for augmentation includes as rights to be augmented: Northglenn Reservoir (proposed); the Bull Canal Reservoir; the South Platte tributary wells Nos. 1 through 5; and, the Grange Hall Creek diversion at Irma Drive. Water rights which will be used for augmentation include the Lower Clear Creek Ditch, Burlington Ditch, Burlington Reservoir, Fulton Ditch, New Brantner Extension Ditch Company, Lupton Bottom Ditch Company, Brighton Ditch, and deep nontributary wells. Water rights on Grange Hall Creek and some storage reservoirs are also included.

The documents requesting legalization of Northglenn's water supply were filed with the Water Court in Division 1, the South Platte River Basin, on August 31, 1979. Other water right users had until October 31, 1979 to protest the action and identify any rights which may be injured by Northglenn's plan. There will then be a period of disucssion and negotiation between Northglenn and objectors to eliminate or reduce the number of issues. It is unlikely that a consent decree covering all issues can be negotiated and the case will be heard by the water judge.

Yield of Augmenting Rights

The yield of the water rights to be used for augmentation was reviewed from preliminary engineering studies provided by Northglenn. EPA concludes that it appears that the water rights represent sufficiently senior rights for augmenting purposes. Water used for augmentation comes from lands historically in agricultural production. Only the agricultural consumptive use can and will be used for augmentation.

Administration

The plan for augmentation is not specific as to details of plan operation and administration. The State Engineer normally assigns only one Water Commissioner to each stream or stream segment for administration. The Northglenn augmentation plan as well as operation of the water supply system is very complex. Operation and proper monitoring will require measuring devices throughout the system and may even require measuring crop consumptive use as well as reservoir evaporation. The State Engineer's office has indicated to EPA that it needs at least one additional employee to properly administer Northglenn's proposed plan.

Ditch Protection

When shares in a mutual ditch company are used for augmenting purposes it is necessary to either transfer the water out of the ditch or divert water from the ditch back to the river source. The other ditch users must be protected from injury and may suffer a loss of water were Northglenn to transfer its shares out of the ditch entirely. Northglenn has stated they will work with the individual ditches to work out a means of insuring that the remaining ditch shareholders are protected. This can be accomplished through the use of augmentation stations, by diverting water from the ditch back to the stream, or by leaving a certain percentage of water right permanently in the ditch equivalent to the pro-rata share of seepage loss. The balance of the water right would be either left in the stream or changed to a new point of diversion where Northglenn could utilize the water for augmentation.

Thornton Enclave

As shown in Table 3-4, the Thornton Enclave is expected to contribute a total of 885 acre-feet per year of wastewater that will be used as replacement water to FRICO by Northglenn. Northglenn's opinion is that this flow does not require augmentation. EPA has no opinion as to whether such flow requires augmentation.

Thornton currently receives its water supply from tributary wells along the South Platte River. The City's wastewater is treated at the Denver Metro sewer district plant and discharged to

TABLE 3-4

NORTHGLENN'S WATER BUDGET

1988 Conditions
(All values in Acre-feet)

CONDITION

	Option 1 Without Deep Wells		Option 2 650 af Deep Wells		Option 3 2300 af Deep Wells		Option 4 Return to Metro	
	Dry	Avg	Dry	Avg	Dry	Avg	Dry	Avg
Treated Water Requirements								
Household and Commercial	4140	4140	4140	4140	4140	4140	4140	4140
Irrigation (lawns and parks)	3200	2700	3200	2700	3200	2700	3200	2700
Total Water Required	7340	6840	7340	6840	7340	6840	7340	6840
Raw Water Sources								
Farmers Highline	69	137	69	137	69	137	69	137
Standley Lake Shares	1074	1504	1074	1504	1074	1504	1074	1504
Church Ditch	135	389	135	389	135	389	135	389
Berthoud Pass Ditch	120	608	120	608	120	608	120	608
Arapahoe Well No. 7	5	5	5	5	5	5	5	5
Proposed Deep Wells	0	0	645	645	2295	2295	0	0
FRICO Owned Water	5937	4197	5292	3552	3642	1902	5937(5)	4197(5)
Total Water Supplies	7340	6840	7340	6840	7340	6840	7340	6840
FRICO Exchange								
Net Amount Rec'd from FRICO	5937	4197	5292	3552	3642	1902	0	0
10% Bonus (500 AF min)	594	500	529	500	500	500	0	0
Reservoir Evaporation	316	236	316	326	316	236	0	0
Total Payback Requirement	6847	4933	6137	4288	4458	2638	0	0
Replacement/Wastewater Return								
Sewage - Northglenn	4016	4016	4016	4016	4016	4016	4016	4016
Sewage - Thornton Enclave[1]	885	885	885	885	885	885	885	885
Sewer Line Infiltration	300	300	300	300	300	300	300	300
Storm Runoff-Grange Hall Crk	1200	0	936	0	0	0	0	0
Tributary well Field	446	0	0	0	0	0	0	0
Total Water Available	6847	5201	6137	5201	5201	5201	5201	5201
Excess Physical Supply[2] (Total Available - Payback Requirement)	0	268	0	913	743	2563	To Metro Sewer for Treatment and release to South Platte River	
Diversions to be Augmented								
Grange Hall Creek	1200	0	936	0	0	0	To Metro Sewer for treatment and release to South Platte River	
Tributary Well Field	446	0	0	0	0	0		
Additional diversion required to irrigate Northglenn lands[3]	0	1332	0	687	0	0		
Total Augmentation Requirements	1646	1332	936	687	0	0[4]		
Augmentation Rights Available								
A-Perm. removed	1002	1301	1002	1301	1002	1301		
B-Used for ag. when possible	518	428	518	428	518	428		
C-Future use unknown	235	220	235	220	235	220		
Total	1755	1949	1755	1949	1755	1949		
Excess Water Rights to Meet Flow Requirements	109	617	819	1262	1755	1949		

(1) An enclave of Thornton will be connected to the Northglenn system.
(2) Excess water available in the system without augmenting which can be used for irrigation of Northglenn owned FRICO land.
(3) The additional water required to be delivered to the Bull Canal to irrigate Northglenn owned FRICO land based on the assumption that all such available land for agriculture will be irrigated in an average year. The physical source of supply may be either Grange Hall Creek or the tributary well field.
(4) There is a surplus of 963 AF over and above the amount required to irrigate Northglenn's FRICO lands.

the South Platte River. The transfer of this wastewater from Thornton to Northglenn depletes the South Platte River and requires augmentation either by Northglenn or Thornton.

The effect of requiring additional augmentation of this flow will be to require more surface water rights. The total diversions to be augmented in Table 3-4 would be increased by 885 acre-feet per year. Therefore, EPA concludes that in some of the options (Option 1 average and dry year and Option 2 dry year) the City does not have adequate augmentation rights available. Additional augmenting rights under these conditions must be obtained.

Grange Hall Creek

Grange Hall Creek is the most convenient and economical source of replacement water subject to water being physically available in the stream. Studies by Northglenn show the entire low flow of the stream may be diverted for Northglenn's use. Only during runoff from snowmelt or storm events greater than Northglenn's ability to divert will water flow down the stream. Except for runoff periods, Northglenn will have the capability of drying up Grange Hall Creek.

While Grange Hall Creek is a small intermittent stream there are some existing water rights along the creek which are senior to Northglenn and must be protected. These rights are owned by one person and total 10.6 cfs. Northglenn intends to augment these rights when legally required to do so by releasing water into Grange Hall Creek from the Lower Clear Creek Ditch, or by releasing Grange Hall Creek drainage runoff to meet the demand of the lower water right users (17).

Legal Issues

In analyzing the water rights and augmentation plans of the Northglenn project, several legal issues were identified. These will be resolved through the Water Court process if necessary and the resolutions could have a significant impact on implementation of Northglenn's Water Management Plan if decisions were adverse to Northglenn.

Listed below is a summary of some of the important issues identified during this analysis:

a. The plan includes successive use of water for both municipal and agricultural purposes. This includes FRICO water owned by Northglenn as well as water borrowed from FRICO. The legal question is whether this successive use is allowed.

b. Northglenn has claimed 100% depletion credit for water stored in Standley Lake. Historically, there has been a certain amount of return flow from agricultural use of this water. The legal question is whether or not any downstream appropriators have a right to the return flow from this irrigation use.

c. Northglenn has claimed a total of 300 acre-feet per year of infiltration into the sewer system as part of the wastewater replacement credit. The basis for this is its contention that the source water is Standley Lake stored water and can be 100% consumptively used. Adversely, it could be argued that some of the infiltration is storm water. Further it is questionable whether Northglenn has retained dominion and control over this water.

d. Standley Lake and the Croke Canal are decreed for irrigation and domestic purposes. The legal question is whether or not a change of water rights to municipal purposes must be included in the plan.

e. Another legal issue is whether or not a shareholder is entitled to water of a quality suitable for a use other than that for which the water has been historically used. This issue involves cities that desire in the future to use the Bull Canal system for domestic water supply.

f. Lining of the Bull Canal system will reduce the amount of seepage to the ground water and may adversely affect irrigators who depend on such seepage. The legal question is whether these irrigators have a vested right to the water.

The above legal questions will be resolved through the judicial process if necessary. It is noted however, that resolution of all of the legal questions will not necessarily insure that all adverse impacts will be mitigated. For example, even though FRICO may legally be able to line the Bull Canal, this action could adversely impact downstream users that have historically depended on seepage water from the canal.

Summary of Legal Issues

EPA concludes that the Northglenn water rights applications, including change of water rights, and the augmentation plan are a logical approach to preventing injury to other vested water rights. Although there are a number of legal issues to be resolved and some changes to the water plan as filed are likely, approval by the Water Court of a water supply plan for the City is likely. The probable effect of any subsequent changes to the plan during the court process will be to require more water to augment these changes in flow.

EPA concludes, based upon expert opinion, that 1) other complex plans with similar principles have been approved by the Water Court and this plan can be administered by the State Engineer; 2) the amount of water obtained from surface sources is reasonable based on historic ditch diversions and stream depletions; 3) the exchange plan will sufficiently protect FRICO shareholders; 4) through the Water Court process, out-of-priority diversions will be properly augmented; 5) the water rights to be used for augmentation are sufficiently senior for that purpose; 6) South Platte water users will be compensated for additional ditch losses.

AGRICULTURAL PRODUCTIVITY

A key issue in evaluating the proposed project is to determine if agriculture is benefited in agricultural productivity. For the areas in question (FRICO and South Platte) the current (1979) average crop value in dollars is presented in Appendix A - Description of the Existing Environment. Because the key element in the analysis is water, the productivities for the two areas are related to farm headgate water deliveries. In 1979 the FRICO productivity is $250 per acre-foot of farm headgate delivery and the South Platte productivity is $109 per acre-foot.

In this analysis, the four options, which have been previously described, have been analyzed.

Water Availability

The amount of water available to the FRICO farmers is dependent on the option chosen. The estimated farm headgate delivery for each of the options is summarized in Table 3-5. The values are based on the schematic diagrams, Figures 3-2 through 3-5 (oversized, back of report) and Table 3-4. The analyses ignore any benefit due to lining of the Bull Canal and assume that the farm headgate deliveries are equal to 60 percent of the sum of the releases from Standley Lake and the FRICO exchange return.

Augmentation

Required augmentation water from surface sources for the four options evaluated is summarized in Table 3-6. As previously discussed, some of the augmentation water will come from lands currently out of agricultural production and some will come from lands currently in production. To determine the impact of each option on agriculture only that water to be taken from lands currently in production is of consequence. (See Table 3-6)

Net Productivity Change

The FRICO and South Platte net agricultural productivities for the four options considered are presented in Table 3-7. The FRICO productivities are based on the farm headgate water deliveries and assumed productivity at $250 per acre-foot of delivery as it is estimated in 1979. The South Platte productivities are based on the estimated water removed from currently productive lands and the estimated 1979 South Platte productivity of $109 per acre-foot

TABLE 3-5

ESTIMATED FRICO FARM HEADGATE WATER DELIVERIES

Option	Description	Water (Acre-Feet)(1) Average Year	 Dry Year
1	Without deep wells	7350[2]	4706
2	650 acre-feet from nontributary wells	7348[2]	4666
3	2300 acre-feet from nontributary wells	7928[2]	5096
4	Water from Standley Lake Wastewater to Metro	3572	788

(1) Equal to 60% of sum of FRICO exchange return and release from Standley Lake (see Figures 3-2 through 3-5).

(2) Includes water required to irrigate Northglenn owned FRICO served land.

of delivery. The net productivity of options 1 through 4 is the FRICO productivity less the South Platte productivity.

Option 4 does not include considerations of any increased productivity along the South Platte due to the additional water that would be discharged to the river from the Metro Plant (433 acre-feet per month). Alternative 4a presents an analysis of the net productivity if it is assumed that this 433 acre-feet per month is only available for six months each year during the growing season. The maximum increased productivity along the South Platte for this additional water based on $109 per acre-foot headgate delivery would be $280,000 per year.

TABLE 3-6

SURFACE WATER AUGMENTATION

Option	Description	Total Required (acre-feet) Average Yr	Total Required (acre-feet) Dry Yr	Water Removed From Currently Productive Agricultural Land (acre-feet) Average Year	Water Removed From Currently Productive Agricultural Land (acre-feet) Dry Year
1	Without deep wells	1332	1646	1260	1551
2	650 acre-feet from nontributary wells	687	936	615	841
3	2300 acre-feet from nontributary wells	0	0	0	0
4	Water from Standley Lake Wastewater to Metro	0	0	0	0

The additional 433 acre-feet per month in the South Platte is less than three percent of the flow in the South Platte River below the Denver Metro Plant. It is unlikely that this flow would result in increased agricultural productivity in the same magnitude as the present South Platte deliveries. Therefore, $280,000 is considered the maximum and in reality the productivity would probably be somewhat less.

The analyses in these Tables assume that the South Platte lands dried up as a result of the project would result in zero agricultural productivity. This in fact may not be the case. It can be assumed that those lands would be converted to nonirrigated agriculture producing crops such as wheat or barley. Table 3-8 presents an analysis of these lands assuming they are planted to nonirrigated wheat.

As can be seen in Table 3-7, the option that contemplates maximum use of nontributary ground water (Option 3) results in the highest net agricultural productivity (least impact). Options 4 and 4a which contemplate Northglenn's acquiring its entire water supply from FRICO by purchase or condemnation with wastewater discharged to the South Platte result in the lowest net agricultural productivity (greatest impact). Bar charts presented in Figure V-6 graphically illustrate the net productivities of the four options in both an average and dry year.

TABLE 3-7

NET PRODUCTIVITY OF FRICO AND SOUTH PLATTE IRRIGATED LANDS AFFECTED BY THE NORTHGLENN PROJECT

(IN MILLION DOLLARS)

Option	Description	FRICO[1]		SOUTH PLATTE[2]		NET PRODUCTIVITY	
		Average Year	Dry Year	Average Year	Dry Year	Average Year	Dry Year
1	Without deep wells	1.84	1.18	-0.38	-0.46	1.46	0.72
2	650 acre-feet from nontributary wells	1.84	1.17	-0.18	-0.25	1.66	0.92
3	2300 acre-feet from nontributary wells	1.98	1.27	0	0	1.98	1.27
4	Water from Standley Lake Wastewater to Metro	0.89	0.20	0	0	0.89	0.20
4a[3]	Same as 4 but assumes So. Platte return has agriculture benefit	0.89	0.20	0.28[4]	0.28[4]	1.17	0.48

[1] Based on $250/acre-foot of delivery. FRICO deliveries given in Table 3-5.

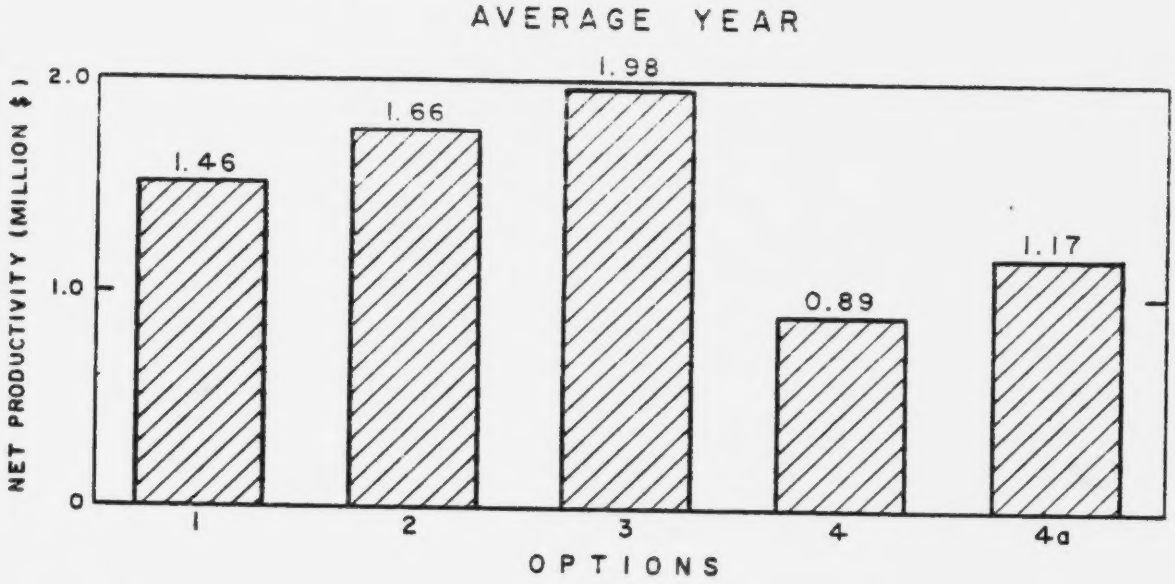
[2] Based on $109/acre foot of water removed from currently productive land (Table 3-6).

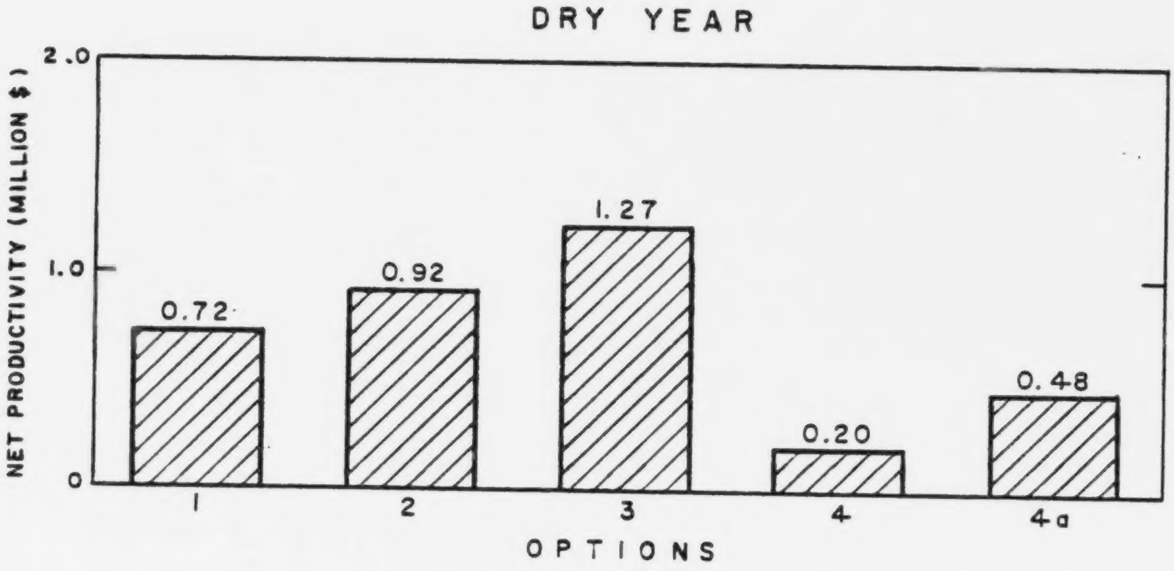
[3] Option 4 plus inclusion of maximum increased South Platte productivity due to metro discharge.

[4] Based on 433 acre feet per month, six months growing season, and productivity at $109/acre-foot of headgate delivery.

FIGURE 3-6

NET AGRICULTURAL PRODUCTIVITY





EPA concludes from this analysis that under the exchange program, positive agricultural benefits are obtained if all the makeup source is derived from deep wells (Option 3). If Northglenn implements an exchange which requires makeup water entirely from other irrigators, (Option 1) then there will be some loss to agriculture but net productivity will be substantially higher than if Northglenn did not execute an exchange agreement (such as Option 4). Therefore EPA concludes that compared to the situation if ongoing litigation would have been successful, the proposed exchange, regardless of which source Northglenn initiates for makeup water, has a net economic benefit to agriculture.

These circumstances indicate that, on balance, Northglenn's stated claims that their proposal enhances agriculture are accurate. The long term exchange arrangement with FRICO enhances the likelihood that significant acreage of irrigated land will remain productive farmland during this century. In conclusion, EPA has determined that this plan meets EPA's policy to protect environmentally significant agricultural land and therefore endorses this proposal in this regard.

TABLE 3-8

DRY LAND PRODUCTIVITY OF SO. PLATTE LANDS DRIED UP AS RESULT OF NORTHGLENN PROJECT

Option	Description	Land Average Yr	Land Dry Yr	Crop Productivity($) Average Yr	Crop Productivity($) Dry Yr
1	Without deep wells	1260	1551	78,000	96,000
2	650 acre-feet from non-tributary wells	615	841	38,000	52,000
3	2300 acre-feet from non-tributary wells	0	0	0	0
4	Water from Standley Lake Wastewater to Metro	0	0	0	0

Assumptions:

1. Land planted to wheat
2. Yield = 16.5 bu/acre
3. Crop value $3.76/bu
4. South Platte current consumptive use is 2.7 acre-feet per acre.

POTENTIAL FOR DRINKING WATER SUPPLY

Concern has been expressed regarding the degradation of the Bull Canal, making its water unsuitable as a raw water supply. Analysis of the limited data currently available indicates that the water is useable as a raw water supply; i.e. suspended solid concentrations are high, no toxic parameters are present. However, projected concentrations of nitrates in the canal after discharge from the proposed facility will inhibit the development of these waters as a water supply, particularly for the Town of Frederick, and possibly could affect a raw water source for the Town of Ft. Lupton.

The State of Colorado defines raw waters suitable for potable water supplies as follows: (3)

> "These are waters which, after receiving approved disinfection such as simple chlorination or its equivalent or which after receiving standard treatment (defined as coagulation, flocculation, sedimentation, filtration, and disinfection with chlorine or its equivalent) will meet Colorado drinking water regulations and any revisions, amendments, or supplements thereto."

Standard water treatment as defined above will not effectively remove nitrate.

Annexation requirements of Frederick, Colorado require that lands brought into the town must also provide additional water supplies. Landowners surrounding Frederick generally own shares in FRICO delivered by the Bull Canal. Therefore, implementation of a plan which discharges effluent to the Bull Canal would render these waters unacceptable as a water supply for Frederick. Filings have not been made to change the use of Bull Canal waters to a water supply and the current Larimer-Weld 208 Clean Water Plan designates the Canal solely for agricultural use. Thus it is EPA's conclusion that the protection of these waters for a potential future water supply source is unnecessary and EPA recommends that Frederick explore other options to satisfy future water supply demands.

Fort Lupton is currently using a shallow well field along the Platte River for their water supply source. However, this source has high nitrates. Sand Hill Lake is an option the Town is considering as a water supply source. Sand Hill Lake is filled by the Coal Ridge Ditch. Concern has been expressed that Bull Canal water will reach the Coal Ridge by way of the containment pond at the terminus of the Bull Canal. Fort Lupton is primarily concerned that nitrates in the Bull Canal resulting from Northglenn's plan will reach the Coal Ridge Ditch and render Sand Hill Lake unuseable as a water supply.

Nitrate concentrations in Coal Ridge Ditch are between 0.9 mg/l and 1.3 mg/l which is well below the water supply criterion of 10.0 mg/l. Sand Hill has a nitrate concentration of 5.5 mg/l probably due to agricultural runoff. The projected Bull Canal nitrate concentration in an average year range from 12 mg/l to 14 mg/l, depending upon the option.

Operation of the Bull Canal is intended to make optimum use of the irrigation water available. FRICO therefore does not deliver water with the intention of having it reach the containment pond since that water is lost. However, during occasional storm events and flushing of the Bull Canal, water does reach the pond and is available for the Coal Ridge Ditch. This reservoir does not have more than 6 acre-feet of water in any one year (1).

The operational flexibility of the Northglenn-Bull Canal reservoir should adequately control effluent mixed water entering Coal Ridge Ditch by way of the containment pond. However, tailwater off lands irrigated below the reservoir discharge point may enter Coal Ridge ditch and then Sand Hill Lake. Data to calculate the increased nitrate concentration in Sand Hill Lake are currently not available. EPA concludes that the Bull Canal will not contribute a significant contribution of water supply to Sand Hill Lake and therefore will not contribute to higher nitrate concentrations there.

OTHER ISSUES

Several other issues of the proposed plan have been identified. These issues are related to specific elements of the plan and various components. The issues are listed below:

- the potential for ground water pollution from lagoon and reservoir seepage
- reservoir stability and safety
- potential odor problems
- effect on relative land values adjacent to the treatment site
- visual or aesthetic effect of the facilities

These issues as they relate to the plan are discussed in the next chapter.

CHAPTER 4

EVALUATION OF ALTERNATIVES

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An important scientific innovation rarely makes its way by gradually winning over and converting its opponents: it rarely happens that Saul becomes Paul. What does happen is that its opponents gradually die out and that the growing generation is familiarized with the idea from the beginning.

Max Plank
The Philosophy of Physics (1936)

CHAPTER 4

EVALUATION OF ALTERNATIVES

INTRODUCTION

The Northglenn water resource plan is a water supply, wastewater treatment, and agricultural reuse project which is predicated on guaranteeing an adequate water supply for Northglenn's future population. This document is specifically concerned with the environmental impacts of the various options considered, the ultimate EPA objective being to determine the eligibility of the wastewater treatment portions of the project for federal assistance under the Clean Water Act (1). In developing and evaluating the options, the water supply and agricultural reuse elements of the plan can not be completely separated. In order to determine eligibility of the wastewater project only the agricultural reuse element is important. Therefore, it is assumed that because of legal obligations Northglenn is committed to the water supply program developed with FRICO. Further, Northglenn has already purchased their wastewater treatment site and developed construction specifications unique to that site. The following provides a summary of the evaluation of water supply and site alternatives that resulted in Northglenn's current course of action.

SUMMARY OF WATER SUPPLY ALTERNATIVES CONSIDERED

The City of Northglenn in March 1976, conducted an analysis of water supply alternatives to substitute for their current supply from the City of Thornton (2). Five alternatives which integrated land and water management were evaluated. These alternatives are identified as:

- Box Elder Creek Water Borrowing
- Develop South Platte/I-76 Well Field
- Standley Lake Exchange (selected)
- Develop Burlington Ditch Wells
- Denver Water Board

Box Elder Creek Water Borrowing

In this alternative, agricultural water would be pumped from agricultural land in Box Elder Creek to Northglenn. This water would be used in the municipal system, collected, and then returned to the farmland for irrigation. Makeup water equal in amount to that consumed within the City would be added to the system from nontributary wells located in and around Northglenn.

Develop South Platte/I-76 Well Field

A well field for municipal water supply would be developed south of Interstate 76, downstream of the Burlington Ditch headgate. This site is upstream of the Denver Metro sewage treatment plant discharge, a distinct advantage over Northglenn's present water source supplied by Thornton. The well field area would be integrated with the Denver Metro South Platte redevelopment project to provide a continuity of river amenities. Water rights would be acquired in harmony with the District No. 2 South Platte agricultural interest so that the nutrient-enriched effluent would be beneficially used through recycling.

Standley Lake Exchange

Initially, Northglenn would borrow water from Standley Lake for municipal use. All water borrowed would be replaced acre-foot for acre-foot to the FRICO shareholders. Makeup water for the municipal consumptive use would come from nontributary wells and the South Platte.

Discussions that further developed this alternative resulted in Northglenn commiting to replacing the borrowed water with a 10 percent bonus and exploring options for makeup water, including deep wells.

Develop Burlington Ditch Wells

A water source would be provided based on wells drilled into terraced areas and the aquifer recharged with high quality spring runoff and the water rights of the Burlington Ditch system. Water borrowed from the agricultural interest would be returned to the ditch with added nutrients to enhance crop yields.

Denver Water Board

The Denver Water Board policy, at the time the analysis of water supplies was conducted, was not to serve any additional areas outside of the Denver city limits or other designated service areas. This policy is commonly referred to as the "Blueline" Policy. This policy precluded Northglenn from being eligible for Denver Water Board water since it is outside the designated boundary. This policy is still in effect.

Northglenn decided to select the Standley Lake exchange due to the adverse environmental implications of the other alternatives. EPA agrees with this selection due to the following factors: 1) a transbasin diversion source, such as seeking a supply from the Denver Water Board, would create salinity problems and minimum flow problems for users on the western slope, 2) development of any deep well source under State law is limited to extraction of such waters to one percent per year and vested in the owner of the land above the formation which limits the supply available to Northglenn from such a source and, 3) purchase or condemnation of agricultural water surplus without return to agriculture harms the important environmental asset of irrigated crop land along the Front Range. Therefore selection of one of the water exchange sources has the least adverse impacts on the environment.

TREATMENT SITE SELECTION

The Northglenn wastewater treatment facilities plan evaluated ten alternative wastewater treatment and reservoir storage facility sites. The locations of the ten sites considered are shown in Figure 4-1.

The complete analysis of each site is presented in Northglenn's application for site approval (3). The following is a summary of that analysis.

Seven criteria were used to evaluate the ten alternative sites. This criteria included:

- compatibility with surrounding land use
- safety of reservoir design
- control of seepage losses
- underlying mineral resources
- operational flexibility
- consistency with approved wastewater management plans
- severability of system components

Compatibility with Surrounding Land Uses

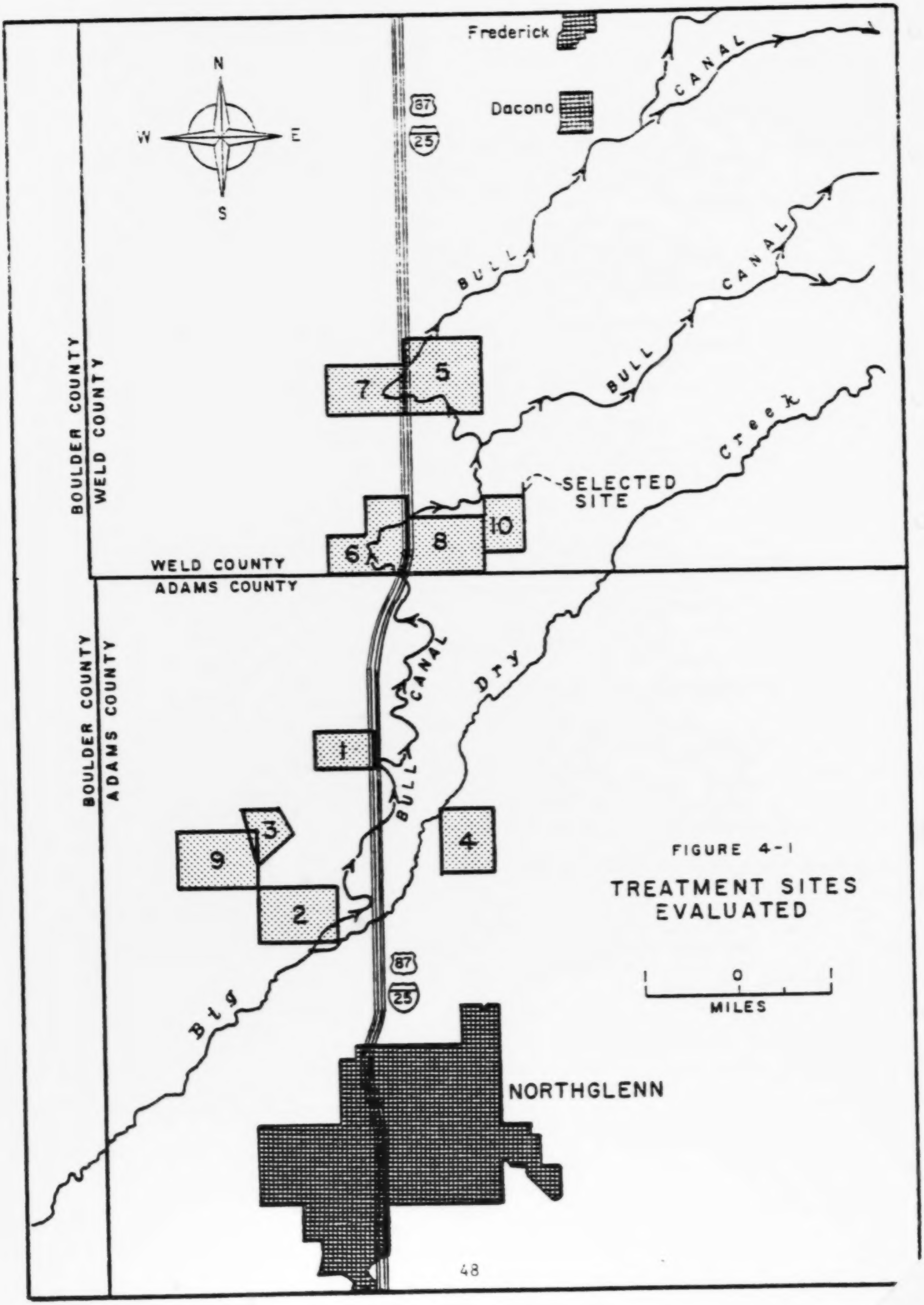
The proposed facility should be compatible with present land uses and future land uses as delineated by comprehensive plans adopted by local and regional governments. Sites in rural areas not scheduled for future urbanization were favored. The number of residential units on the site and within one-half mile of the proposed facility was also an important consideration.

Safety of Reservoir Design

The proposed facility includes a reservoir to store wastewater during the nonirrigation season. Potential flood hazards and geologic hazards such as earthquakes and subsidence were factors in comparing the candidate sites.

Control of Seepage Losses

The amenability of each site to the control of reservoir seepage losses, for the conservation of water and the avoidance of any potential pollution of ground water aquifers was evaluated. Sites underlain by naturally impervious materials that would supplement man-made seepage control measures were favored.


Frederick
Dacono
N
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CANAL
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BULL
CANAL
Creek
Dry
Big
SELECTED SITE
BOULDER COUNTY
WELD COUNTY
WELD COUNTY
ADAMS COUNTY
BOULDER COUNTY
ADAMS COUNTY
1
2
3
4
5
6
7
8
9
10
BULL
CANAL
87
25
NORTHGLENN
0
MILES

FIGURE 4-1

TREATMENT SITES EVALUATED

Underlying Mineral Resources

The construction of any facility at a poorly selected site might preclude the future development of underground resources such as gravel, coal and oil. The selection process favored sites which were not underlain by any economically recoverable resources.

Operational Flexibility

The proposed facilities must be integrated into a comprehensive plan to manage the water resources of the Northglenn/FRICO plan. Sites adjacent to the Bull Canal were favored since the treated wastewater would be discharged to the canal. Storage sites capable of receiving Bull Canal flows by gravity were favored since such a configuration allows storage of canal flows during flood periods. This promotes the conservation of available water supplies for beneficial uses. Weld County sites were favored since the majority of the FRICO water users are located in Weld County and preferred a Weld County site. In addition, FRICO wanted the quality of the effluent from the treatment facility monitored by Weld County Health Department personnel.

Consistency with Approved Wastewater Management Plans

An application has been made for federal funds under the construction grants program of the Clean Water Act. The site therefore must be environmentally acceptable and consistent with an approved Northglenn facility plan and the 208 Wastewater Management Plan. The proposed site must also be cost effective under EPA's construction grant regulations.

Severability of System

Some commenters have suggested that the proposed facilities should be separated, and that the aeration lagoons should be constructed within the Northglenn city limits. Neither of these alternatives was found to be practicable or desirable.

Since the storage reservoir is an integral part of the treatment process, there will be more effective quality control and flexibility of operation with the lagoons and reservoir at one location. If one of the aerated lagoons must be drained for scheduled maintenance, the lagoon water can be discharged directly into the reservoir. Significant construction, operation, and maintenance cost savings will be realized if the lagoons are adjacent to the reservoir. Common embankments can be used and the necessity of constructing and staffing two separate maintenance facilities can be avoided.

The evaluation of the ten sites concludes that Site 10 is the preferred location. This site is a 321.7 acre parcel in southern Weld County that is zoned agricultural and is outside areas designated for future urban development. Construction of the proposed facilities at this site would not displace any existing residences or businesses. However, there are 18 residences and one business located within one-half mile of the site. The site is adjacent to the Bull Canal which is to receive the treated wastewater. This facilitates storage and management of the wastewater. According to the analysis of the site it is not underlain by any active geological faults nor economically recoverable mineral resources. A nearby vertical inactive fault may underlie the northwest corner of the site. The site is underlain by impervious materials and is not located in an aquifer recharge area. The evaluation of this site further concludes that it is cost-effective and compatible with adopted water quality management plans. The site has received approval by the Weld County Planning Commission (3).

The remaining sites evaluated were rejected because of the following reasons:

- displacement of existing residences and/or businesses (Sites 1 through 9)
- located in area planned for future urban development (Site 2)
- underlain by geologic faults, abandoned coal mine, natural gas line, and/or economically recoverable mineral resources (Site 2 and sites 4 through 9)
- presents difficulties in storage and management of Bull Canal flows (Sites 1 through 5, 7, and 9)
- underlain by permeable materials or unproven impermeable materials related to seepage control (Sites 1, 2, and 4 through 8).

Northglenn concluded that the selected site is consistent with surrounding land use policies and applicable wastewater management plans. It would result in the least impact on the surrounding residences and businesses and would best promote design safety and efficiency. The overall impact of constructing and operating the facility at this site would be minimal.

Between the Northglenn Wastewater Facilities Plan and the Lower South Platte Facility Plan, a total of 21 alternatives to treat Northglenn's and Thornton's wastewater were evaluated. Most of these alternatives involved treatment of Northglenn's and Thornton's wastewater at the Metro, Westminster, or Brighton facilities or some combination thereof.

The Lower South Platte Facility Plan, approved by EPA, recommends that wastewater flows in these two service areas be treated in the Big Dry Creek Basin at the City of Westminster Plant primarily because of the opportunities to reuse the effluent within this drainage basin. The Northglenn Plan evaluated ten alternatives, all of which involved construction of a new treatment facility at a new location rather than using existing facilities such as Westminster's or Metro's.

A preliminary screening of the 21 alternatives eliminated all those that were too costly. EPA reviewed this information and concluded that the cost of treatment at the Westminster facility is about equal to the cost of treatment at the proposed Northglenn facility. Therefore, a single plant configuration does not appear to have any advantages over a two plant configuration for the Big Dry Creek Basin. Based on EPA's review, continued treatment at the Metro facility is the least cost pollution control alternative for the Northglenn and Thornton service areas. The Metro alternative does not have the same benefits as the Northglenn proposal. These benefits include: 1) an improved water supply (quantity and quality); 2) formation of a city/farmer exchange agreement over the use of water in the basin; 3) development of agreements with farmers which will be a positive factor toward the preservation of agricultural land; and 4) a reduction in the amount of energy consumed in the disposal of Northglenn's wastewater.

EPA concludes that the selection of a separate facility for Northglenn that includes agricultural reuse is consistent with previous facility planning efforts. EPA also concludes after reviewing the proposed treatment site, that this site is acceptable.

NO FEDERAL ACTION ALTERNATIVE

The "No Federal Action" alternative includes a denial or failure by EPA to make a grant to the City of Northglenn for wastewater treatment. Such a denial by EPA could be based on a finding of ineligibility under the Clean Water Act, significant unavoidable adverse environmental impacts, or other reasons. Northglenn's total water management program is expected to cost $67 million with $6.9 million eligible under EPA regulations. As only 10% of the capital costs and none of the annual costs are expected from the federal government, Northglenn has indicated to EPA that they will still proceed with the project in the absence of federal funds. Thus, it is possible that Northglenn will complete the water management program entirely with local funds should EPA deny or fail to make a grant.

The consequences of "no federal action" are then very similar to Northglenn's proposal except that those grant conditions required by EPA for additional public health protection need not be executed by Northglenn. The Colorado Health Department could impose similar contions through the NPDES permit if they decided to do so. EPA would negotiate with the Health Department to secure such conditions as tailwater control, additional disinfection and protection of Dacono's water supply. Northglenn may decide to implement these or similar conditions on their own.

SUMMARY OF WATER MANAGEMENT OPTIONS

Northglenn's basic water supply program involves borrowing water from FRICO, which will be used along with water it owns, to meet its municipal water requirement. To evaluate the effects of Northglenn's plan, several options were selected for analysis. These options are schematically represented on Figures 3-2 through 3-5 (oversized - back of report). The options include:

1. No deep well supply other than Arapahoe Well No. 7
2. A deep well supply equal to 650 acre-feet per year
3. A deep well supply equal to 2300 acre-feet per year
4. Acquisition of water required for municipal purposes from FRICO with treatment at Denver metro. Discharge will be to the South Platte River.

Shown in Figures 3-2 through 3-5 are estimates of the annual yield or water requirement at various points throughout the FRICO-Standley Lake system. Details of the water budget for each of the options are shown in Table 3-4. The options were analyzed on the basis of depletion and yield studies provided by the consultants for the City of Northglenn and independently reviewed by an EPA consultant.

Under terms of the agreement between Northglenn and FRICO, replacement water is required to make up for the municipal use loss and to provide for the ten percent bonus to FRICO. Replacement water will be diverted from Grange Hall Creek or the tributary well field. Both will have essentially the same overall depletion effect on the South Platte system as water will be taken out of priority and augmentation is required to protect other appropriators. Northglenn proposes that water will normally be taken first from Grange Hall Creek as pumping costs are less. The tributary well field will be used to supplement diversions from Grange Hall Creek.

To provide augmentation rights, Northglenn has purchased land and water rights in FRICO and along Clear Creek and the South Platte River. This water will be used when out-of-priority diversions from Grange Hall Creek or the South Platte tributary well field are made. When this occurs some lands will be taken out of production. A summary of the expected future use of the land and water rights owned by Northglenn is shown in Figure A-2, oversized - back of report.

As discussed previously, Northglenn has filed application for nontributary ground water beneath the City. It is their intention that this water will form a part of the City's raw water supply as illustrated in Figures 3-3 and 3-4. The amount of nontributary ground water used will reduce the amount of water borrowed from FRICO which reduces the amount of water to be returned. Because it is nontributary Northglenn will not have to provide augmentation rights for this water.

Discussed in the following paragraphs are each of the options.

Option 1

Illustrated in Figure 3-2 are the water requirements and augmentation amounts required under Option 1. Under this option, the only nontributary ground water included is that already approved by the State Engineer to Arapahoe Well No. 7. The total yield of surface water rights owned by Northglenn available for the City's water supply system in a dry year is 1398 acre-feet, and in a year of average water availability, 2638 acre-feet. Arapahoe Well No. 7 yields 5 acre-feet per year in both dry and average years. During a dry year, the municipal water requirement is 7340 acre-feet and Northglenn will need to borrow a total of 5937 acre-feet from FRICO. Similarly, in an average year with a requirement of 6840 acre-feet a borrow of 4197 acre-feet will be needed.

The primary reason dry year water requirements for a city are greater than an average year is because of the need for more lawn watering and other uses outside the home. The domestic and commercial water demand and wastewater flow is essentially constant. The total amount of wastewater estimated for all options is 5201 acre-feet. This includes wastewater from an enclave of Thornton and sewer system infiltration.

Under this option, in a dry year Northglenn will be required to return to FRICO 6531 acre-feet of water, including the bonus. The total replacement water requirement is 316 acre-feet greater because of reservoir evaporation loss. The amount of replacement water for an average year is determined in a similar manner and additional water (1332 acre-feet) has been added to continue to irrigate Northglenn owned FRICO lands.

For Option 1, diversions to be augmented are 1646 acre-feet (1200 acre-feet from Grange Hall Creek and 446 acre-feet from the tributary well field) in the dry year and 1332 acre-feet (from Grange Hall Creek) in an average year. In Table 3-4 the augmentation rights available are 1755 acre-feet in the dry year and 1949 acre-feet in an average year.

For all of the options, the numbers presented in Figures 3-2 through 3-5 and Table 3-4 are based on the current Northglenn proposals and the augmentation plan submitted to the Water Court. The final augmentation plan approved by the Court may be different.

Option 2

The schematic representation of Option 2 is shown in Figure 3-3. This option includes a total of 650 acre-feet of nontributary ground water as an inflow to the water system both in dry and average years. The amount of borrow required from FRICO is 5292 acre-feet for a dry year and 3552 acre-feet for an average year. The total payback requirement including reservoir evaporation is 6137 acre-feet in a dry year and 4288 acre-feet in an average year. The amount of water required to be augmented is 936 acre-feet in the dry year and 687 acre-feet in an average year. Augmentation requirements are less in this option because of the use of nontributary well water that does not need augmentation.

Option 3

Option 3 is similar to Option 2 except that a total of 2300 acre-feet nontributary ground water is available. This option is illustrated in Figure 3-4 . In this option the amount of borrow from FRICO is 3642 acre-feet in the dry year and 1902 acre-feet in an average year.

Under this option, the deep well supply reduces the amount of borrow from FRICO so that the wastewater return is more than adequate to meet both dry year and average year payback requirements and no augmentation is required. The amount of excess wastewater flow over the required payback is 743 acre-feet in the dry year and 963 acre-feet in an average year.

Option 4

Option 4 is an alternative to the exchange plan with FRICO. The amount of water required to meet Northglenn's municipal requirements is acquired either by purchase or condemnation from FRICO. Instead of returning wastewater for agricultural purposes, it is treated at Denver's Metro Plant and released to the South Platte River. As there are no out-of-priority diversions in this option, augmenting rights are not required. The water supply to Northglenn is covered by owned water rights and water rights acquired from the Standley Lake system. The depletion due to the municipal use is less than the historic agricultural depletion and therefore no other rights would be injured.

Under this option the 5201 acre-feet of wastewater that is returned to FRICO under options 1 through 3 would be available in the South Platte. This is equal to 433 acre-feet per month.

WATER QUALITY

Public Health

Options 1, 2, and 3 will discharge into the Bull Canal. This effluent will degrade the existing water quality of the Bull Canal and in certain dry year conditions water below the discharge point will consist of 100 percent effluent. Public health risks associated with this degradation are identified in Chapter 3. The health risks are in areas where public contact and exposure with the wastewater, particularly 100 percent effluent are likely to occur. Health risks are also identified with using the wastewater for irrigation of vegetable gardens on farms and raw edible food crops grown for public sale and consumption.

Although it is not clear based on limited data whether Bull Canal is currently suitable as a domestic supply, future water quality of the Bull Canal below the discharge will be unsuitable as a water supply source after discharge by Northglenn because nitrate concentrations range between 12 mg/l and 20 mg/l. Currently no filings have been made to change the use of the Bull Canal to include water supply as a protected use. (See analysis of Potential Drinking Water Supply in Chapter 3.)

Irrigation Water Quality

The projected total nitrogen concentrations in the Bull Canal at the point of wastewater discharge are presented in Table 4-1. As a worst case condition in a dry year the canal below the discharge will consist of 100 percent effluent.

Sugar beets and barley are the nitrogen sensitive crops grown with Bull Canal water. The optimum nitrogen uptake of sugar beets is 81 pounds per acre per year (lb/ac/yr), and for barley it is 75 lb/ac/yr. The total nitrogen delivered is presented in Table 4-2 for the three options.

TABLE 4-1

TOTAL NITROGEN CONCENTRATION IN BULL CANAL

Option	Effluent Concentration	Average Year Concentration
1	15-20 mg/l	8.8-11.5 mg/l
2	15-20 mg/l	7.9-10.5 mg/l
3	15-20 mg/l	6.6-8.6 mg/l

TABLE 4-2

TOTAL NITROGEN DELIVERY TO SUGAR BEETS AND BARLEY

	Total Nitrogen Delivery (lb/ac/yr)			
	Dry Year		Average Year	
Option	Sugar Beets	Barley	Sugar Beets	Barley
1	42-56	42-56	25-32	14-18
2	42-56	42-56	22-29	12-17
3	42-56	42-56	18-24	10-14

The projected nitrogen concentrations in Northglenn's effluent should not exceed the recommended application rates for either sugar beets or barley. Concentrations will approach the optimum nitrogen uptake of sugar beets and barley in a dry year if effluent nitrogen concentrations reach 29 mg/l and 48 mg/l, respectively. That is at these concentrations, which are higher than expected, all the crop nitrogen demand could be provided by the effluent.

While total nitrogen concentrations are not expected to cause problems in either sugar beet or barley production, management of water applications to sugar beets will be necessary to satisfy Great Western's contractual agreements of no nitrogen after July 15 of each year.

Water Quality Effects on Livestock

There is little quantitative information available concerning the tolerances of livestock to various water quality parameters. The permissible concentration of various substances in water depends, to some extent, on the daily water consumption of the animal. It appears that animals can tolerate higher salinities than humans, and it is conceivable that they differ in their tolerances of specific elements (4). Waters with high concentrations of nutrients (nitrogen and phosphorus) consumed by livestock can cause physiological disturbances such as gastrointestinal symptoms, wasting disease and death. Among the functions of animals, lactation and reproduction are generally the first to be disturbed by continuous use of water with high nutrient concentrations. Adverse effects of high salinity waters on livestock are due to the osmotic pressure of the total salts present rather than the toxic effect of any one constituent (5). In addition to the effects of the total salt concentration, some salts are specifically toxic to animals, even in very low concentrations. Among the compounds of concern in water are nitrates, fluorides, and the salts of selenium and molybdenum. Tables 4-3 and 4-4 provide a set of recommendations for maximum levels of various elements in drinking water supplies to livestock. The Northglenn effluent quality is expected to remain within these recommended limits, thus posing no threats to livestock. Neither is it expected that drinking reclaimed water would make animal tissues unwholesome for human consumption.

The issue of nitritis (toxicity to cattle caused by high nitrite concentrations in silage) has been expressed. This situation occurs when nitrate is taken up by corn in high concentrations. When the corn is stored as silage and anaerobic conditions occur, the biological activity that occurs converts nitrate to nitrite which can be toxic. Nitrate applications to corn will not be excessive under the plan, provided application of chemical fertilizers is reduced to compensate for nitrates in the wastewater. This problem can further be mitigated by maintaining aerobic conditions in stored silage.

TABLE 4-3

GUIDE TO THE USE OF SALINE WATERS FOR LIVESTOCK AND POULTRY

Total Soluble Salts Content of Waters(mg/l)	
Less than 1 000 mg/l (EC < 1.5)	Relatively low level of salinity. Excellent for all classes of livestock and poultry.
1 000 - 3 000 mg/l (EC = 1.5 - 5)	Very satisfactory for all classes of livestock and poultry. May cause temporary and mild diarrhea in livestock not accustomed to them or watery droppings in poultry.
3 000 - 5 000 mg/l (EC = 5 - 8)	Satisfactory for livestock, but may cause temporary diarrhea or be refused at first by animals not accustomed to them. Poor waters for poultry, often causing water feces, increased mortality and decreased growth, especially in turkeys.
5 000 - 7 000 mg/l (EC = 8 - 11)	Can be used with reasonable safety for dairy and beef cattle, for sheep, swine and horses. Avoid use for pregnant or lactating animals. Not acceptable for poultry.
7 000 - 10 000 mg/l (EC = 11 - 16)	Unfit for poultry and probably for swine. Considerable risk in using for pregnant or lactating cows, horses, or sheep, or for the young of these species. In general, use should be avoided although older ruminants, horses, poultry, and swine may subsist on them under certain conditions.
Over 10 000 mg/l (EC > 16)	Risks with these highly saline waters are so great that they cannot be recommended for use under any condition.

Source: Environmental Studies Board, Nat. Acad. of Sci., Nat. Acad. of Eng. Water Quality Criteria 1972

TABLE 4-4

RECOMMENDATIONS FOR LEVELS OF TOXIC SUBSTANCES IN DRINKING WATER FOR LIVESTOCK

Constituent	Upper limit
Aluminum (al)	5 mg/l
Arsenic (As)	0.2 mg/l
Beryllium (Be)	No data
Boron (B)	5.0 mg/l
Cadmium (Cd)	.05 mg/l
Chromium (Cr)	1.0 mg/l
Cobalt (Co)	1.0 mg/l
Copper (Cu)	0.5 mg/l
Fluoride (F)	2.0 mg/l
Iron (Fe)	No data
Lead (Pb)[a]	0.1 mg/l
Manganese (Mn)	No data
Mercury (Hg)	.01 mg/l
Molybdenum (Mo)	No data
Nitrate + Nitrite (NO_3-N+NO_2-N)	100 mg/l
Nitrite (NO_2-N)	10 mg/l
Selenium (Se)	0.05 mg/l
Vanadium (V)	0.10 mg/l
Zinc (Zn)	24 mg/l
Total Dissolved Solids (TDS)	10,000 mg/l

[a] Lead is accumulative and problems may begin at threshold value = 0.05 mg/l

Source: Environmental Studies Board
"Water Quality Criteria 1972"
National Academy of Science, National Academy of Engineers.

EPA Funding Criteria

The 1977 amendments to P.L. 92-500 ennuciate a major policy of promoting the use of innovative and alternative waste management techniques, with special focus on the municipal waste treatment program. Though mentioned only briefly, innovative and alternative technology was explicitly encouraged in the 1972 law - but few projects applied such technology, largely because of perceived greater risks and higher costs on the part of water quality administrators, public health officers and consulting engineers.

Congress, therefore, used the 1977 amendments to require every community seeking an EPA grant for construction of wastewater treatment facilities to fully evaluate innovative and alternative treatment options. Innovative and alternative techniques taken together foster three central objectives: recycling and reuse of water and waste materials, energy conservation and recovery, and cost reduction.

Innovative refers to new and promising technology which is not yet fully proven under the circumstances of its intended use. In conventional treatment systems, innovative describes technology which reduces life cycle costs by 15 percent or more, or reduces the amount of energy required for waste treatment by at least 20 percent. Innovative can also refer to new technology which advances the state of waste treatment art.

Alternative technology is better known than innovative, offering treatment approaches which are clearly alternative to conventional secondary and advanced waste treatment processes. Included in this category are such techniques as land treatment, aquifer recharge, water reclamation and reuse, use of nutrients, direct industrial reuse of effluents, composting and land application of sludge, and anaerobic digestion of sludge to produce methane.

To encourage the use of innovative and alternative treatment facilities, Congress provided, in the act, that such facilities be funded at 85 percent of construction costs rather than the normal 75 percent. To provide funds for the increase, two percent (fiscal year 1979-1980) of construction grant funds allocated to each state (three percent in fiscal year 1981) must be set aside for innovative and alternative facilities, with at least one-half of one percent earmarked for innovative facilities. This two percent set-aside is considered the maximum amount that states may use to supplement the basic 75 percent wastewater treatment works construction grant; therefore not all projects proposing innovative or alternative technology will receive the ten percent supplemental grant. Single-purpose projects using innovative or alternative techniques qualify for the 85 percent grant if their life cycle cost under a cost-effectiveness analysis does not exceed the life cycle cost of the most cost-effective conventional alternative by more than 15 percent. Within two years from the date of final inspection, EPA will pay 100 percent of the costs of modifying or replacing any innovative or alternative treatment facility which does not meet design performance standards and for which correction of the failure requires significantly increased capital or operation and maintenance costs.

EPA Multiple-Purpose Construction Grants Requirements

Generally EPA awards construction grant funds for wastewater treatment works which are shown to result in the minimum total resource cost over time and be adequate to meet Federal, State or local requirements. A cost-effectiveness analysis is used to screen different alternatives in order to determine the least cost wastewater treatment alternative. Should a municipality desire to undertake a project that simultaneously performs a wastewater treatment function and another function EPA can participate in the funding under multiple-purpose project funding criteria.

The current funding policy of EPA for the design and construction of most types of multiple-purpose projects is stated in Program Requirements Memorandum 77-4 (6). This memorandum enunciates the Alternative Justifiable Expenditure (AJE) method for cost sharing; it has been used since 1976, primarily in projects which involve combined sewer overflow and urban drainage problems. The AJE method is founded on the assumption that achieving multiple purposes simultaneously should be less costly than achieving them separately, and all purposes should share in the cost savings. Thus, the funding for a project under this policy is less than it would have been had the project been designed for the single purpose of pollution control.

EPA is presently in the process of developing a method for funding multiple-purpose projects which involve innovative and alternative technology to apply the incentives for innovative and alternative technology that were provided by the 1977 Clean Water Act Amendments. In June of 1979 the Office of Water and Waste Management of EPA distributed "Strategies for Funding of Multiple-Purpose Projects"(7).

Seven alternatives were given for funding of multiple-purpose projects.

1. Keep the status quo. Use the Alternative Justifiable Expenditure (AJE) method for allocating costs, except for recreation projects where the eligibility level is the same as the single-purpose wastewater treatment project.

2. Make all multiple-purpose projects eligible at the cost level of the least costly conventional wastewater treatment single-purpose project.

3. Make all innovative/alternative multiple-purpose projects eligible at 115 percent of the single-purpose cost, and all non-innovative/alternative projects at the single-purpose level. (The actual rule in this option is somewhat more complex, employing a ratio of the present worth costs of the single-and multiple-purpose projects.) This is the funding alternative selected by EPA for the Northglenn project.

4. Use the same eligibility rules as option 3, except make certain reclamation and reuse projects fully eligible--those in which the reuse replaces existing water withdrawal and leaves water in the stream which is required by a water-quality standard or a water-quality

management plan, for a guaranteed period of 20 years. Expand the definition of "Enforceable Requirements of the Act" so as to make these reclamation projects eligible for placement on the state priority list.

5. Use the same eligibility rules as option 3, except that all reclamation and reuse projects would be fully eligible. Revise the priority system process so that the list is based on a ranking of all surface and ground water quality problems. Also, expand the definition of enforceable requirements as in option 4.

6. Use the same eligibility rules as in option 5. Expand the definition of enforceable requirements, and institute limits on the proportion of state allotments which can be used to fund reclamation and reuse projects.

7. Fully fund "integrated facilities" as defined in section 201(e) of the Clean Water Act, and all other multiple-purpose projects at the level of the single-purpose project.

It should be noted that the implementation of options 4 through 7 may require that a legislative change be made.

EPA Region VIII has been directed by EPA, Washington to use option 3 for funding the Northglenn project. Option 3 employs this eligibility formula for innovative/alternative technology projects: 115 percent of the ratio of (a) the present worth cost of the most cost-effective single-purpose option, to (b) the present worth cost of the multiple-purpose project, with a minimum eligibility of 115 percent of the capital cost of the single-purpose alternative. This formula calculates the fraction of the multi-purpose project costs which are eligible for EPA funding. Portions of a multi-purpose project which involve innovative or alternative technology are eligible for an 85 percent grant. Other portions are eligible for a 75 percent grant. This grant amount is therefore 85 percent or 75 percent of the fraction of the multi-purpose project cost that is eligible. The extra 10 percent grant for innovative or alternative wastewater treatment technology grants is taken from limited, set-aside funds for each State. This money will be allocated at the direction of the State.

For EPA to participate in the funding of a multiple-purpose project, the following should apply:

1. The cost of the multiple-purpose project must not exceed the sum of the costs of the most cost-effective single-purpose options which accomplish the same purposes.

2. The primary and secondary environmental effects must be assessed in accordance with the NEPA review procedures, and the project must not have any significant net adverse environmental effects.

3. At least one of the purposes must be necessary to meet an enforceable requirement of the Act.

4. There is no purchase of existing facilities with federal funds.

5. The project meets the definition of treatment works, and the works are publicly owned.

6. The project is consistent with the adopted and approved water quality management plan.

7. For agricultural reuse projects a commitment to this use for the design life of the project is necessary.

Northglenn meets all of these requirements (see Chapter 1 - EPA decision.)

Application of EPA Funding to the Northglenn Project

The application of option 3 for Northglenn requires that two costs be used, the present worth cost of the Northglenn Multi-Purpose Project and the present worth cost of the most cost effective single purpose wastewater treatment alternative which was determined to be continuing the conveyance of Northglenn's wastewater to the Denver Metro wastewater treatment plant for treatment.

Although at present the wastewater from the City of Northglenn is treated at Denver Metro, there are costs associated with this alternative. Expansion of the secondary treatment capacity of the treatment plant is necessary in order to enable the treatment plant to continue to meet its present effluent limitations and treat increased projected flows from the service area (8). In addition, the Denver Metro discharge permit requires that the treatment plant be upgraded to meet more stringent effluent requirements, including nitrification of the effluent. Capital costs of the treatment of Northglenn's flow at the Denver Metro facility were determined to be the difference between the costs of building facilities that are designed to handle the projected design year capacity with and without the design flows from Northglenn. The operation and maintenance costs of the treatment of Northglenn's flows at Denver Metro were determined by the pro-rated fraction of the total operation and maintenance costs.

If Northglenn were to continue to have its wastewater treated at Denver Metro for the 20-year planning period, the capacity of the existing interceptor system which conveys Northglenn's flow to Denver Metro would be exceeded (9). Costs were developed for an interceptor and force main system that could accommodate the increased projected flows. This system would serve Northglenn and part of Thornton. The cost of this system that was attributed to Northglenn was a pro-rata share of the capital and operation and maintenance (O&M) cost based upon Northglenn's flow and the total flow.

For the purpose of calculating the EPA funding of the Northglenn project, it has been determined that the multi-purpose project will be considered to be a wastewater treatment and agricultural reuse project.

Therefore, portions of the Northglenn Water Resource Management Plan, which involves domestic water treatment and distribution, water supply, and urban runoff control, will not be included as part of the cost of the project. The parts of the project that shall be included are the costs of required wastewater collection, system changes, the conveyance of wastewater to the treatment plant site, wastewater treatment, wastewater storage, and measures taken to monitor and control potential adverse impacts of the reuse plan. The purchase of the existing wastewater collection system by Northglenn was not considered as a cost of the project in the analysis since it involved the transfer of existing facilities between municipalities.

Shown in Table 4-5, the funding ratio for the Northglenn project is calculated to be .67. The construction costs of the eligible portions of the project were therefore multiplied by .67 to find the eligible fraction of each item. EPA Construction Grant funds may then be used to pay 75 percent or 85 percent of this eligible fraction. EPA has determined that only the storage reservoir and the facilities that are planned to monitor and mitigate impacts of the agricultural reuse system are eligible for EPA funding at the 85 percent level since these items relate directly to the alternative function of the project - agricultural reuse. The extra 10 percent grant is taken from limited funds that have been set aside for alternative wastewater treatment technology projects which will be allocated by the State of Colorado. It is therefore unclear at this time if this money will be made available to Northglenn.

The Step 3 EPA Construction Grant estimate was determined to be $6,948,000 if the alternative wastewater treatment technology funds are allocated to Northglenn and $6,503,000 if the alternative technology funds are not made available by the State.

TABLE 4-5

GRANT ESTIMATE

Funding Ratio:

$$\frac{\text{Costs of Treatment at Denver Metro + Costs of Conveyance to Denver Metro}}{\text{Cost of Northglenn Multi-Purpose Project}} \times 1.15$$

$$\frac{5{,}095{,}000 + 5{,}434{,}000}{18{,}067{,}000} \times 1.15 = .6702$$

Item	Cost Estimate*	Eligible Fraction	75% Grant	Bonus for Alternative Technology
Treatment Lagoons	$3,450,700	(.6702)(.75)	$1,734,494	$ 426,321
Storage Reservoir	6,361,100	(.6702)(.85)	3,197,407	
Force Main	2,139,500	(.6702)(.75)	1,075,420	
Pump Station A	712,600	(.6702)(.75)	358,188	
Field Monitoring Program	77,500	(.6702)(.85)	38,955	5,194
Dacono Disinfection	32,500	(.6702)(.85)	16,336	2,178
Firestone & Frederick Tailwater Control	163,700	(.6702)(.85)	82,284	10,971
			$6,503,084	$ 445,654

TOTAL - $6,947,748 (rounded - 6,948,000)

*The actual cost will be the construction bid amount (See Appendix C for further details of these cost estimates).

OTHER DIRECT EFFECTS

Changes in Tax Revenue

Northglenn has purchased approximately 1840 acres of land in Weld County and 49 acres of land in Adams County in order to obtain water rights for the water resource management plan. This results in a net loss in taxes to both counties because municipalities are tax exempt. The loss of these irrigated lands from the tax rolls of Weld County and Adams County will result in a loss in tax revenues of $8,000-8,500 and $180-300, respectively.

These values are considerably less than the preliminary tax losses presented at the Northglenn Panel Meeting on September 13, 1979. The values presented at the Panel Meeting, which were indicated as being preliminary and subject to revision, are not tax losses but represent the assessed valuation of Northglenn owned land in Weld County.

Effect on Land Values Adjacent to Treatment Site

To evaluate the effects of a sewage lagoon on land values in an agricultural area, three realtors from Louisville, Colorado, and a land assessor from Boulder, Colorado were contacted (10, 11, 12, 13). Louisville and Boulder were selected because the rural-residential-agricultural nature of land surrounding their wastewater treatment plants has similarities to the proposed Northglenn plant location. Louisville has a lagoon within one-half mile of the community and Boulder has a mechanical plant near its eastern edge.

Two of the three realtors in Louisville were not aware of the presence of the lagoon adjacent to their community. It has been EPA's experience that unless a lagoon is controversial and a public stigma is attached to the facility and the land around it, there is no real reason for land values to decline because of construction of the facility. Suburban residences immediately downwind of the Boulder facility are still in demand and it is estimated that prices there are depressed no more than five percent. The value of agricultural land around the Louisville lagoon has not decreased in value. Good farmland is in such demand that proximity to the lagoon is not a factor.

It is concluded that the effect of the Northglenn facility on surrounding land and residential values will be minimal. A decrease of up to five percent of residential value may occur but farmland values should not be effected.

Ground Water Pollution from Lagoon/Reservoir Seepage

Subsurface investigations (14, 15) have been performed at the treatment plant and storage site. Exploratory borings indicate that the overburden soils and bedrock vary with respect to depth and classification. The bedrock is predominantly claystone with some claystone - siltstone deposits.

Water pressure tests were conducted to evaluate the permeability of the subsurface formations. The results indicate that the siltstone is relatively impervious with variable coefficients of permeability (1 to 60 feet/year). Higher permeabilities were detected at the interface of the claystone and sandstone lenses with a maximum value of 2400 ft/yr and a general range of 60 to 530 ft/yr. Claystone permeabilities are erratic and vary from 20 to 1000 ft/yr. The claystone becomes less pervious with depth.

Undisturbed samples collected at the storage reservoir site were tested and found to have a coefficient of permeability less than 1 ft/yr. This tends to indicate that leakage occurs in joints and fractures within the claystone.

Exploratory borings show an erratic free water level. Depths as shallow as 7 feet exist in the northwest protion of the site. This water is believed to be perched water caused from seepage from the adjacent Bull Canal. Other boring locations indicate water depths of 11 to 28 feet.

Although the permeabilities are generally low, there is a possibility for rapid movement through joints, fractures, and bedrock interfaces. An inactive fault trace may underlie the northwest corner of the proposed reservoir. Water movements along such fractures must be reduced to prevent ground water contamination by the overlying wastewater and treated effluent. To satisfy this requirement the proposed Northglenn treatment facility and storage reservoir will be lined with random clay fill material from the excavation site. The design requires scarifying the reservoir and lagoon bottom soils to a depth of at least six inches and recompacting the soil to a 95 percent density. Northglenn states that if granular soils or fractured materials are encountered in the reservoir bottom, they will be covered with two feet of selected, compacted impervious fill material. EPA will require as an alternative to this that Northglenn consider moving the entire dike south to exclude such a fault trace if present. Resolution of the problem will be done following removal of overburden down to the competant zone. (See special construction condition in Chapter 5.)

The estimated seepage of the lined reservoir after 95 percent compaction is estimated to be 0.5 feet per year. The proposed lagoon and reservoir has an area of 110 acres. The anticipated total seepage volume per year is 55 acre-feet. Based on a void ratio of 25 percent in the soils below the reservoir, the radial movement of seepage is estimated to be two feet per year.

During the subsurface investigation, many holes were drilled or augered along the dam axis and throughout the area to be ponded, which have created possible zones of permeability. These penetrations are from 10 feet deep to 66 feet deep.

A study by the USGS and State Engineer's office involved two deep (1550 feet) monitoring wells within the impoundment area. These cased holes will be abandoned and replaced by agreement between Northglenn, the previous owner, and USGS. A third hole, 600 feet deep, was drilled by the Chen Engineering and Associates under contract with Northglenn.

Each penetration below the pond elevation base of 5120 feet needs to be considered as a possible source of fluid loss. EPA has determined that these penetrations will need to receive special attention before the compaction of the pond base or the dike construction.

EPA will require that all shallow test holes within the reservoir site that have a depth greater than 30 feet below the pond base must be plugged with concrete. Any test holes that have a depth of less than 30 feet must be back filled and compacted. The cased USGS test wells (BW-77-15B and BW-77-17B) must be pressure plugged with concrete from the bottom up to insure proper abandonment. (A special construction condition has been developed for this problem and is described in Chapter 5.)

In addition to the rate of movement, the concentrations of the potential contaminants must be considered. Biological oxidation in the aerated lagoon will reduce certain chemical constituents in magnitude while others will be converted to another form. For instance, the biochemical oxygen demand (BOD) will be reduced by at least 90 percent and ammonia/ammonium will be oxidized to nitrite/nitrate.

Some chemical components of wastewater which remain after treatment are potential ground water pollutants. Most wastewater pollutants that pass into the soil will be filtered out, adsorbed, or exchanged with other ions within the soil matrix. Nitrates, soluable salts, and some heavy metals however, readily move through the soil matrix and are of particular concern as ground water contaminants.

The clay liner in addition to EPA's special construction conditions on handling of the fault trace and sealing of wells, should limit the percolation of wastewater to an acceptable and practical volume as designed.

Monitoring wells are proposed for the treatment plant and storage reservoir site. Periodic chemical analysis will indicate any seepage effects on ground water quality.

Potential Odor Problems

The Odor Emission Regulation of Colorado (16) prohibit emissions of odorous air contaminants from any single source such as result in detectable odors which are measured in excess of the following limits:

- For areas used predominantly for residential or commercial purposes it is a violation if odors are detected after the odorous air has been diluted with seven (7) or more volumes of odor free air.

- In all other land use areas it is a violation if odors are detected after the odorous air has been diluted with fifteen (15) or more volumes of odor free air.

The "worst case" for potential odor problems is to assume that the aeration system is not operating and wind conditions do not allow for dispersion of the generated odor. Four "worst case" meteorological conditions were examined to determine approximately how far odorous air could travel from the proposed Northglenn treatment site before being diluted seven and fifteen times, respectively. The four "worst case" conditions tested were for:

- most unstable dispersion (Stability Class A)
- neutral dispersion (Stability Class D)
- stable dispersion (Stability Class E)
- very stable dispersion (Stability Class F)

The height of the odorous air, assuming the aeration system is not functional above the lagoons/reservoir, is estimated to be ten meters (33 feet). This is the minimum emission height for an area source like lagoons. Accounting for this emission height, wind speed, and downwind distances for effective vertical mixing, the distances to seven and fifteen dilutions were calculated (17). The results of this analysis are presented in Table 4-6 and illustrated in Figure 4-2.

A very stable atmosphere, evident of a strong low-level temperature inversion accompanied by low wind speed, is the "worst case" meteorological condition for the dispersion of odorous air. Hourly wind data from Stapleton International Airport show that Class E and Class F stabilities occur 6.7 and 16.7 percent of the time, respectively, for wind speeds from one to seven miles per hour (mph). The Class F category, for this analysis, is the worst case condition. Under the Class F category (winds 1 to 7 mph) the wind speed frequency is further separated into winds 1 to 3 mph and 3 to 7 mph. The wind speed frequency of 1 to 3 mph occurs less than half of the time, while wind speed frequency between 3 to 7 occurs about 66 percent of the time. The wind speed frequency by direction at Stapleton Airport is presented in Table 4-7 . The diurnal drainage flow in the South Platte River Valley may be more evident with on-site meteorological data, but data from Stapleton International Airport are considered representative of long-term averages for this area.

Accounting for both the topography and diurnal air drainage flows at the proposed site the most likely areas effected by odorous air will be in a northeasterly and southeasterly direction. The area within a radius of 2.55 miles from the site is calculated to be a maximum that could be effected by odorous air prior to 15 dilutions

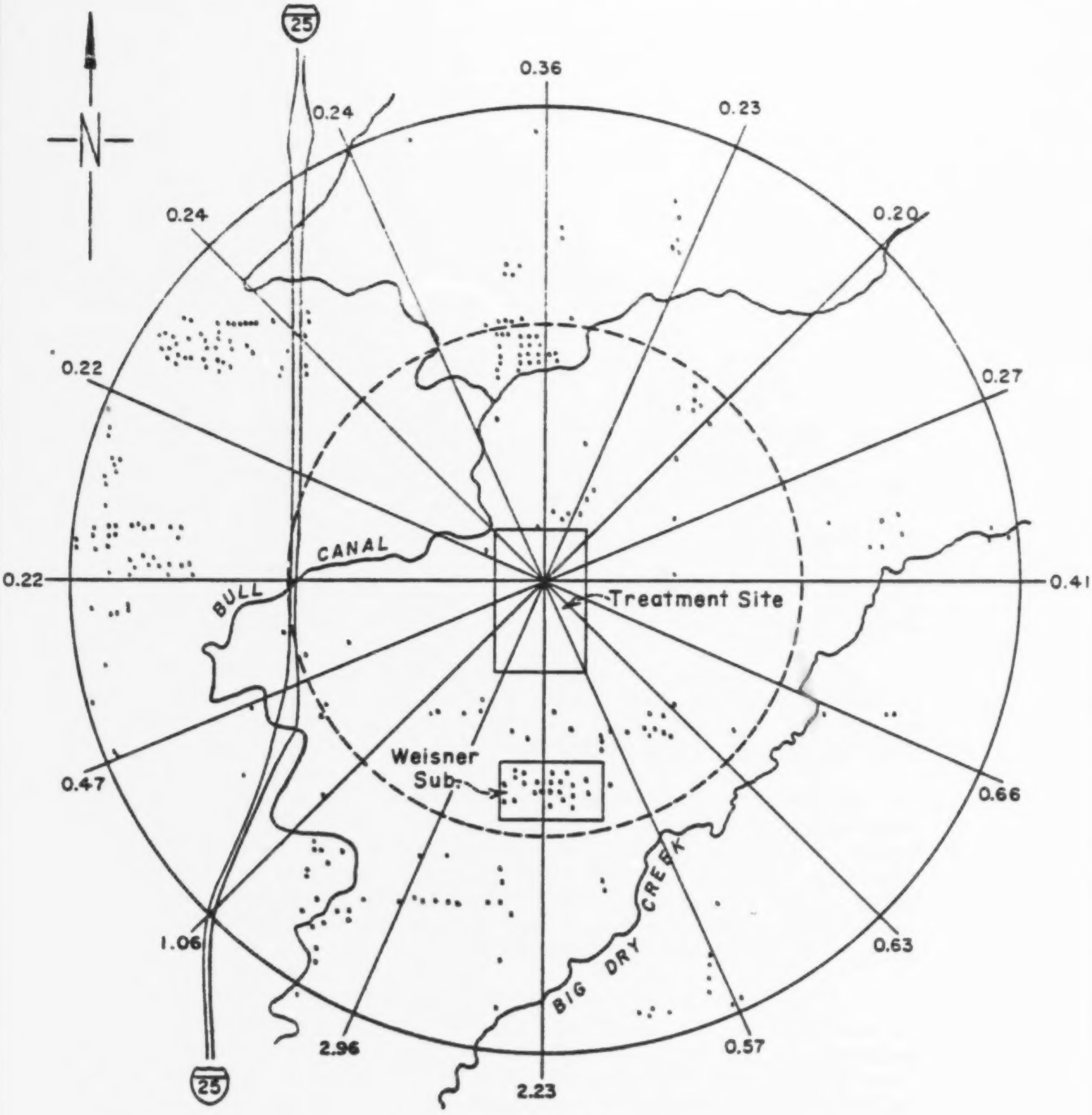

N
25
0.36
0.24
0.23
0.24
0.20
0.22
0.27
0.22
0.41
CANAL
BULL
Treatment Site
0.47
0.66
Weisner
Sub.
CREEK
DRY
BIG
1.06
0.63
2.96
0.57
2.23
25

FIGURE 4-2

WORST CASE ODOR ANALYSIS

(using Class f wind stability – wind speed 3 to 7 mph
and an inoperative aeration system)

LEGEND

⁘ Buildings (Residential, Agricultural and Commercial)

—— Estimated area exceeding 15 dilutions

---- Estimated area exceeding 7 dilutions

Base: USGS, Weld County, Colorado 1978.

0 1
MILE

TABLE 4-6

ODOR ANALYSIS

Meteorological Condition	Distance to Seven Dilutions		Distance to Fifteen Dilutions	
	Kilometers	(Miles)	Kilometers	(Miles)
Unstable (Class A)	0.21	(0.13)	0.35	(0.22)
Neutral (Class D)	0.85	(0.53)	1.35	(0.84)
Stable (Class E)	1.27	(0.79)	2.37	(1.47)
Very Stable (Class F)	2.10	(1.30)	4.10	(2.55)

under worst case conditions. The maximum area for odorous air impact to acheive 7 dilutions has a radius of 1.3 miles.

Potential odor sources at the proposed plant include: 1) raw wastewater entering the plant; 2) dredging accumulated sludge from the aerated lagoons; 3) odors emitted due to plant upset conditions; and, 4) ultimate sludge disposal.

In the proposed facility raw wastewater enters through a closed "force main" pipe to a covered concrete inlet structure. The wastewater is then conveyed to the aerated lagoons through pipes that discharge below the lagoon water surface. Based on analyses prepared by Northglenn's engineer there will be a dissolved oxygen concentration greater than 2 mg/l at the plant site and therefore no sulfide odors would be generated.

It has been estimated by Northglenn's engineer that sludge will be removed from the plant every five to ten years. Some odor is possible during dredging. Measures such as dredging only on calm days which limit the transport of odors or on days which the prevailing wind direction is away from developed areas would reduce odor complaints. Also, the operation should be well planned so the dredging process is completed in the shortest period of time and the sludge removed to the disposal site.

Final sludge disposal will be by tank truck injecting the sludge into nearby agricultural land. There are expected to be minimal odors from this operation.

Aerated lagoons generally are a reliable treatment method that have few plant upsets. The Northglenn plant design is based on a concept that has not been proven in full scale operation. The process according to Northglenn's engineer will control algae by limiting the

TABLE 4-7

1960-1964 Hourly Relative Frequency Wind Data Summarized for F Stability from Stapleton International Airport, Denver, Colorado (2)

Wind Direction	Wind Speed Frequency % (1-2 mph)	Wind Speed Frequency % (3-7 mph)	Total % (1-7 mph)
N*	0.25	0.36	0.61
NNE*	0.21	0.23	0.44
NE	0.19	0.20	0.39
ENE	0.24	0.27	0.51
E	0.26	0.41	0.67
ESE	0.29	0.66	0.95
SE	0.37	0.63	1.00
SSE	0.31	0.57	0.88
S	0.89	2.23	3.12
SSW	0.98	2.96	3.94
SW	0.47	1.06	1.53
WSW	0.32	0.47	0.79
W	0.18	0.22	0.40
WNW	0.13	0.22	0.35
NW	0.29	0.24	0.53
NNW*	0.18	0.24	0.42
TOTAL	5.56	11.11	16.67

*Wind directions that will effect the Weisner Subdivision which is the highest concentration of residences within one mile of the proposed facility.

carbon source through removal of alkalinity by total nitrification. Presuming the continued operation of the aeration system, there should be little likelihood of plant upsets and operational problem that would result in odors.

Considering the general south or southwest wind direction and speed in the vicinity of the plant, and the limited likelihood of strong odor problems at the plant, the frequency of any odor problems for residences near the proposed lagoons will be small. Although residences within a half mile of the facility may experience infrequent doses of odor under certain wind conditions, the closest residential area, the Weisner subdivision, is not in the direction that the prevailing winds blow during expected worst case conditions.

Reservoir Safety and Stability

The reservoir embankment stability analysis is based on two reports provided by Northglenn (14, 15). Review of these reports concludes that the subsurface and geological investigations for the proposed reservoir site have been adequate.

However, information contained in the September 12, 1979 (15) report indicate that the analysis was not based on final design of the reservoir.

Earthquake Analysis

In the Earthquake Susceptibility Evaluation of the report the Denver Seismic Zone is noted as the feature most likely to have a seismic effect on the Northglenn reservoir area. On page 15 it states that "it is unlikely that future earthquakes (in the Denver Seismic Zone) would exceed magnitudes greater than 5.5 to 6.0 (on the Richter Scale)" (15). This infers that a maximum design earthquake of magnitude 6.0 should be considered. On page 17 is stated "selected a pseudo static seismic coefficient of 0.05 g for the operational base earthquake and 0.10 g for the maximum design earthquake". The pseudo static seismic coefficient of 0.10 g was used in the stability analysis of the reservoir (18). For the Denver Seismic Zone an operational base criteria of 0.05 g, pseudo static seismic coefficient for an earthquake magnitude of 5.3, and 0.10 g for a maximum design earthquake of 6.1 Richter magnitude are reasonable based on U. S. Army Corps of Engineer criteria.

Embankment Stability Analysis

The stability analysis methods used are the most commonly used for these types of analysis. A detailed review of the adequacy of the analysis is beyond the scope of this review. However, safety factors arrived at in the analysis appear to be based on accepted criteria (19).

Seepage

The influence of underseepage and the resulting pore water pressures on the stability of the embankment are significant factors in the dam stability analyses. Pore water pressures should be monitored as indicated. However, this can be better accomplished by installing piezometers instead of observation wells, because the observation well will at best show a composite flow water surface. The results of the water pressure testing were correctly analysed as primarily the result of secondary permeability.

Embankment Construction

The material to be excavated from the reservoir area appears adequate for the embankment construction. Recommended construction practices are along the lines of the Bureau of Reclamation Standards (20).

The report calls for a four foot freeboard with 18 inches of rip-rap on the reservoir face of the embankment, but does not go into the matter of how these design criteria were arrived at. The freeboard of four feet was determined on the basis of an effective fetch of 2,355 feet and a design wind velocity of 63 miles per hour. No indication is given as to whether or not wave run-up was considered in the determination of freeboard.

This report further states that "An impervious asphalt liner will be placed along the inside face of the embankment from top to bottom to prevent wave action damage to the embankment. The asphalt liner will consist of a 3½ inch layer of hydraulic asphalt concrete, a 1½ inch thick binder course and a 5-inch drain course". Based on the analysis described by Mostertman (21) it would appear that with the use of an asphalt liner the wave run-up would result in a required freeboard in excess of 6 feet. Calculations for a rip-rap facing indicate that 50% of the stone used should have a diameter of 15 inches or greater rather than the 12 inches mentioned in the report.

From the information supplied it can not be concluded whether consideration has been given to potential embankment damages arising from ice formation or the potential of damages from earthquake generated waves.

In a recent discussion (22) it was discovered that a third stability analysis report has been prepared which more specifically evaluates the proposed reservoir and lagoons. This report could not be obtained in a timely manner to be reviewed and encorporated into this assessment. However, discussion of the questions and issues raised in the review of the September 12, 1978 report indicate the final stability analysis adequately resolved the questions raised.

Visual Features

The proposed reservoir and lagoons will alter the topographic features of the immediate area. The greatest impact will occur during construction when exposed soil will contrast with surrounding vegetation. However, as vegetation establishes on the slopes of the facility this impact will be significantly reduced. Analysis of the visual features of the area indicate that the rolling terrain of the area will aid in further reducing the visual effects beyond the immediate site.

The proposed facility, lagoons and reservoir, is illustrated in Figure 4-3. This rendering is looking north with the Bull Canal illustrated in the upper left hand corner. Shown in Figure V-9 and V-10 is the facility in profile. Figure 4-4 is the north-south axis viewed from the west. Figure 4-5 is the east-west axis viewed from the south. The vertical and horizontal scales differ for illustration purposes. Figures 4-6 to 4-9 are "before" and "after" illustrations of the facility. Figures 4-6 and 4-7 represent the view from Weisner Subdivision, south of the proposed site. Figures 4-8 and 4-9 represent the view of the site from Interstate 25, north of the Base Line Road intersection (Weld County-Adams County Line).

EPA concludes that due to the vegetation effort planned by Northglenn and the low profile of the facility, the visual intrusion is a minor impact.

Energy Sources

With the rising costs of conventional energy sources it has become necessary to evaluate the cost-effectiveness of alternative sources of energy. Several additional sources are available. Wind and solar energy sources are the most feasible alternatives to consider for this project.

Solar energy is a clean energy alternative. Several types are commercially available, the variation being in the medium used, i.e. air, water, etc., depending on the type selected and the solar characteristics of the geographical location.

The Northglenn project includes a control building at the aerated lagoon treatment plant. The building design has incorporated passive solar design features including window positioning and partial burying to conserve heat. The building design also has included a heat recovery system that will heat the building with heat recovered from aeration blowers.

Another form of alternative energy is the conversion of wind forces into electrical power.

For wind energy to be an economical power source the average annual wind speed should be greater than 10 mph - ideally at least 14 to 15 mph, since this criterion is essential for a cost-effective design.

An approximate cost of wind energy is $25/sq. ft. of rotor. The rotor area is dependent on the quantity of energy required. At current energy costs the capital recovery time for a wind energy system is 6 to 16 years, depending on the type of application (23).

Wind energy could potentially be used to supply the power necessary to operate the aeration system of the proposed Northglenn treatment plant. The average annual wind speed at Stapleton Airport is 9.5 mph (24). This value is close to the critical value (10 mph). Anemometer data at the treatment plant site are necessary for final analysis.

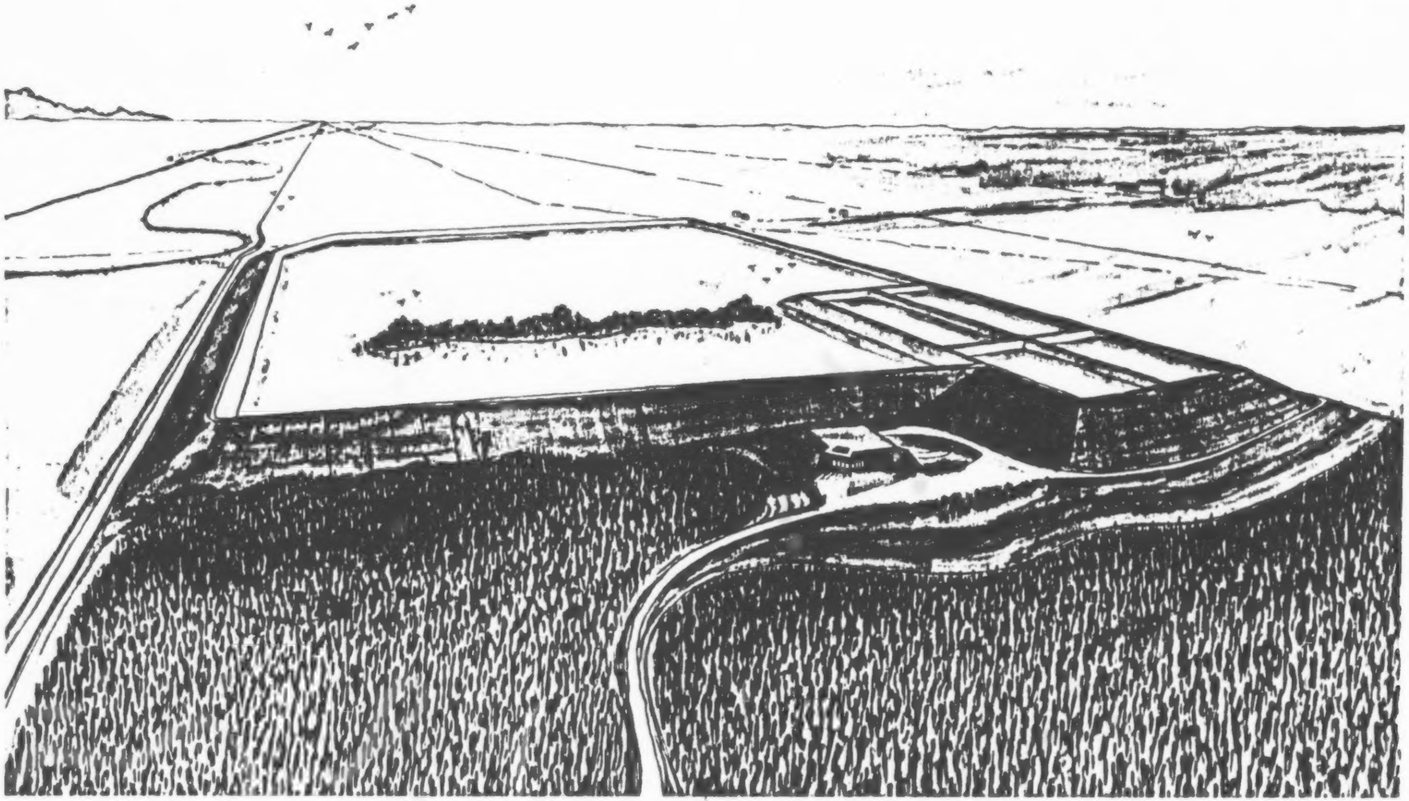


FIGURE 4-3

Artist's Rendition of the Northglenn Bull Canal Treatment Facility and Reservoir

(Aerial oblique view looking north)

FIGURE 4-4

VISUAL IMPACTS

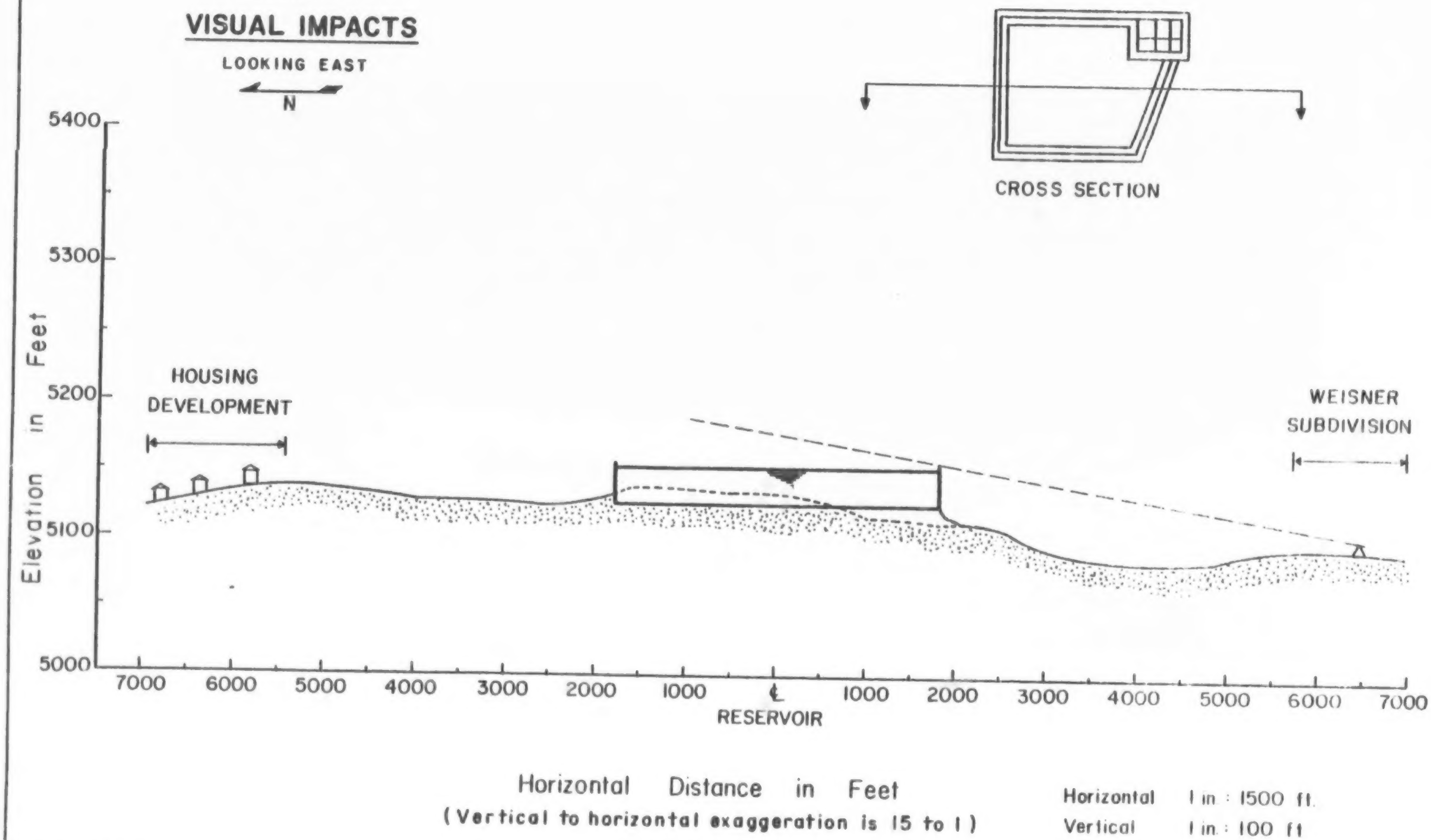
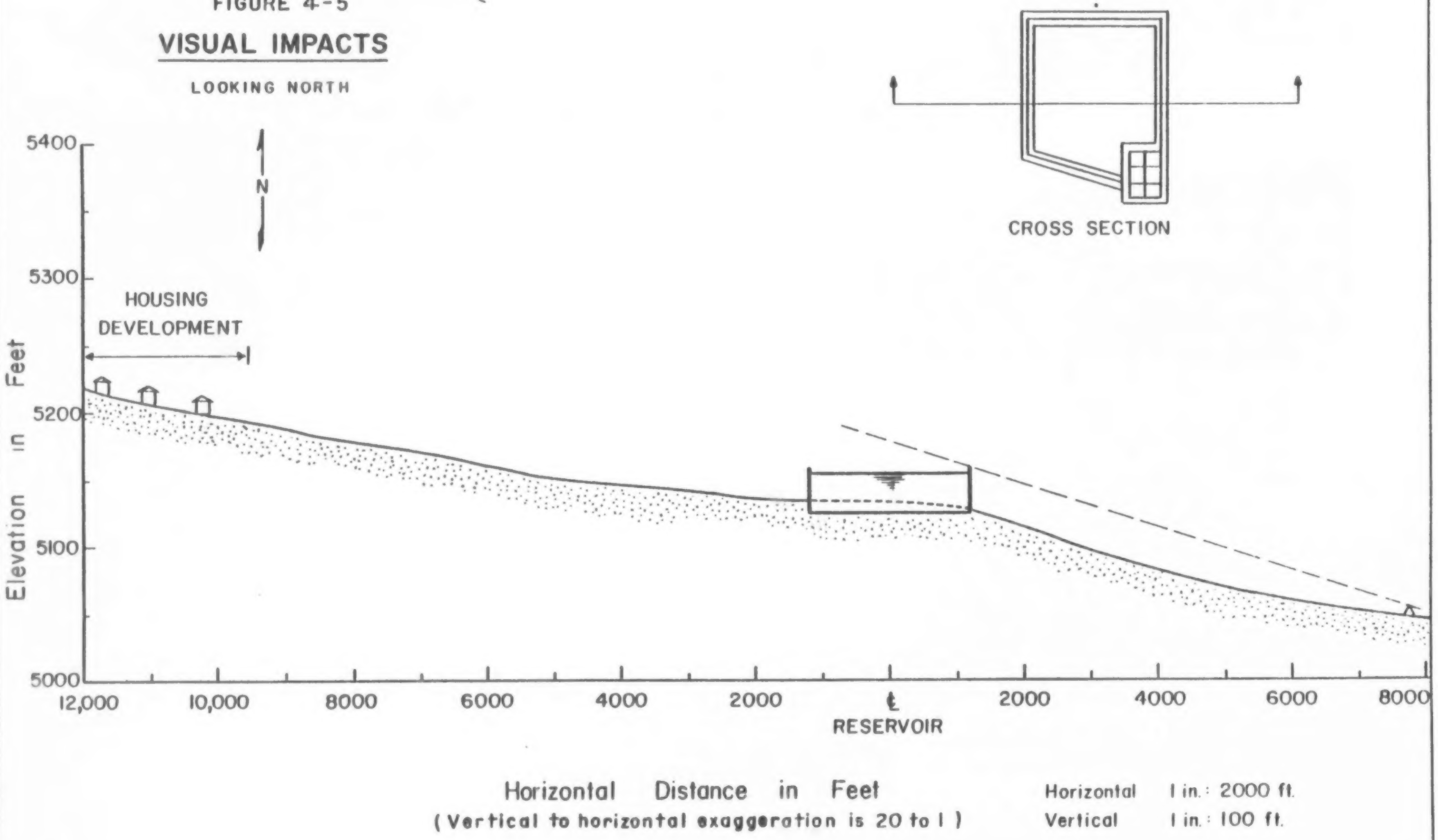

LOOKING EAST
N
CROSS SECTION
Elevation in Feet
5400
5300
5200
5100
5000
HOUSING DEVELOPMENT
WEISNER SUBDIVISION
7000
6000
5000
4000
3000
2000
1000
℄
RESERVOIR
1000
2000
3000
4000
5000
6000
7000
Horizontal Distance in Feet
(Vertical to horizontal exaggeration is 15 to 1)
Horizontal 1 in : 1500 ft.
Vertical 1 in : 100 ft

FIGURE 4-5

VISUAL IMPACTS

LOOKING NORTH


N
CROSS SECTION
HOUSING DEVELOPMENT
5400
5300
5200
5100
5000
Elevation in Feet
12,000
10,000
8000
6000
4000
2000
℄
RESERVOIR
2000
4000
6000
8000
Horizontal Distance in Feet
(Vertical to horizontal exaggeration is 20 to 1)
Horizontal 1 in.: 2000 ft.
Vertical 1 in.: 100 ft.

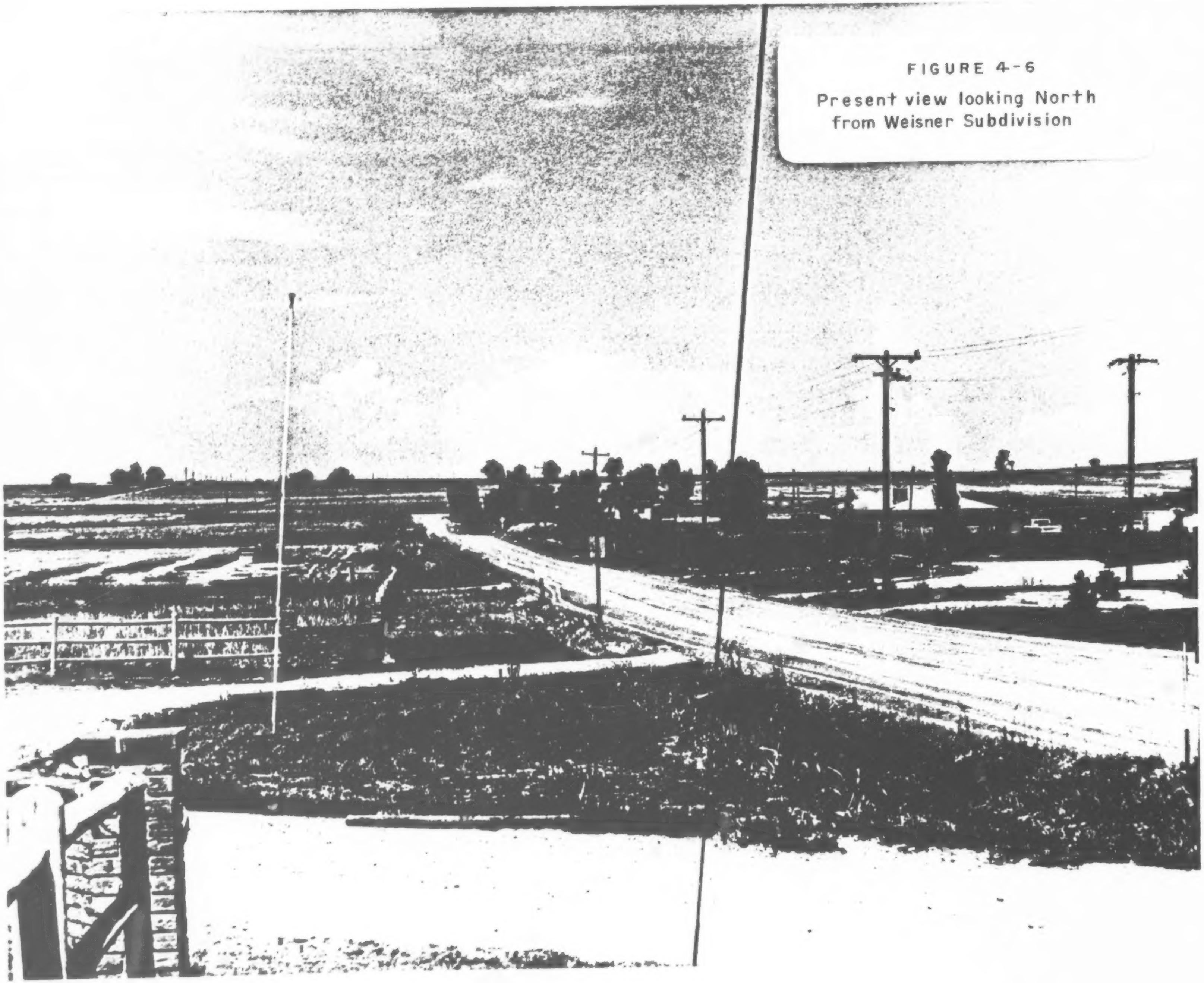
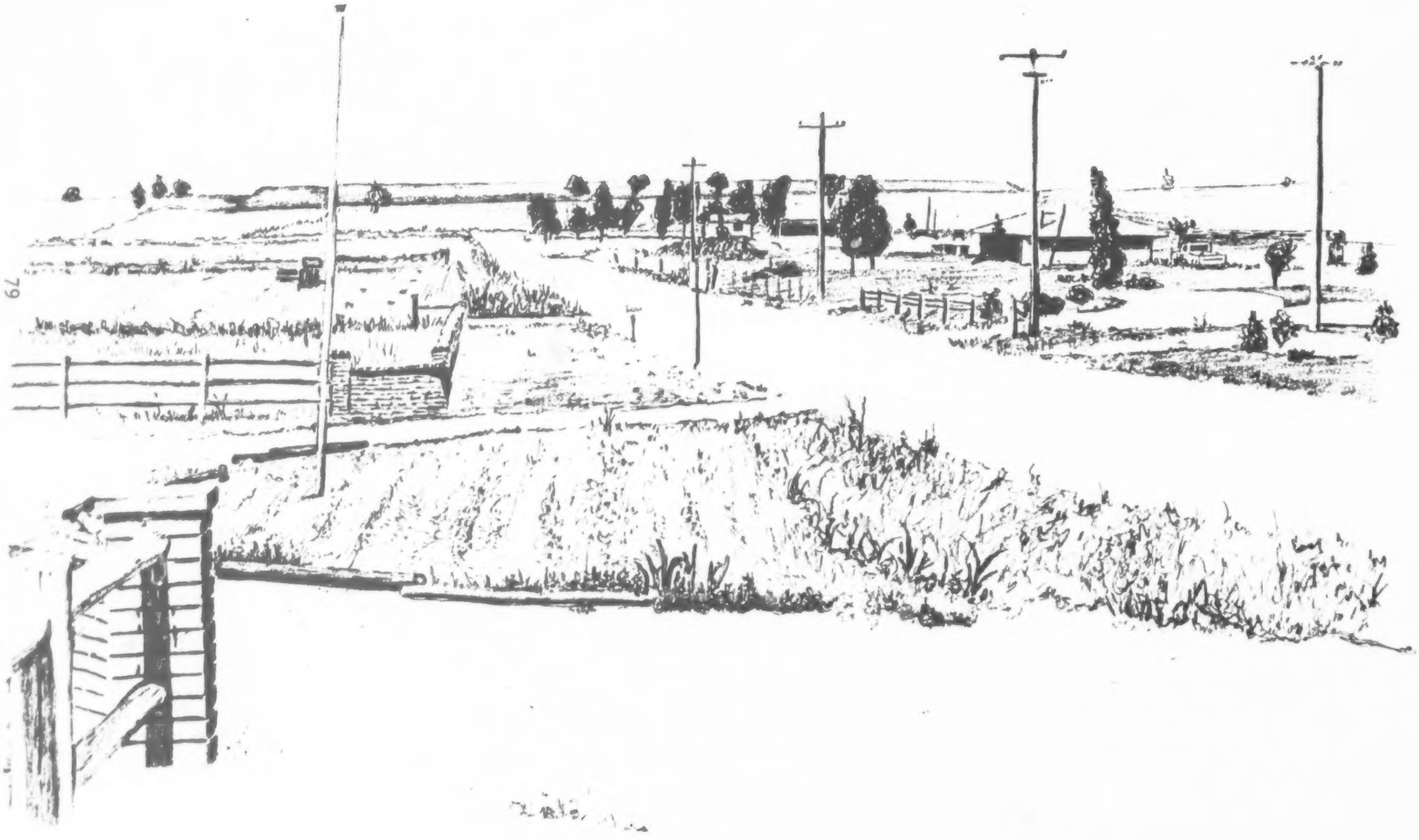


FIGURE 4-6

Present view looking North from Weisner Subdivision

FIGURE 4-7

Future view looking North from Weisner Subdivision



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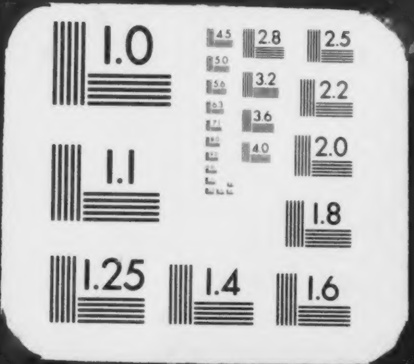

1.0
4.5
2.8
2.5
5.0
5.6
3.2
2.2
6.3
3.6
7.1
4.0
2.0
1.1
1.8
1.25
1.4
1.6

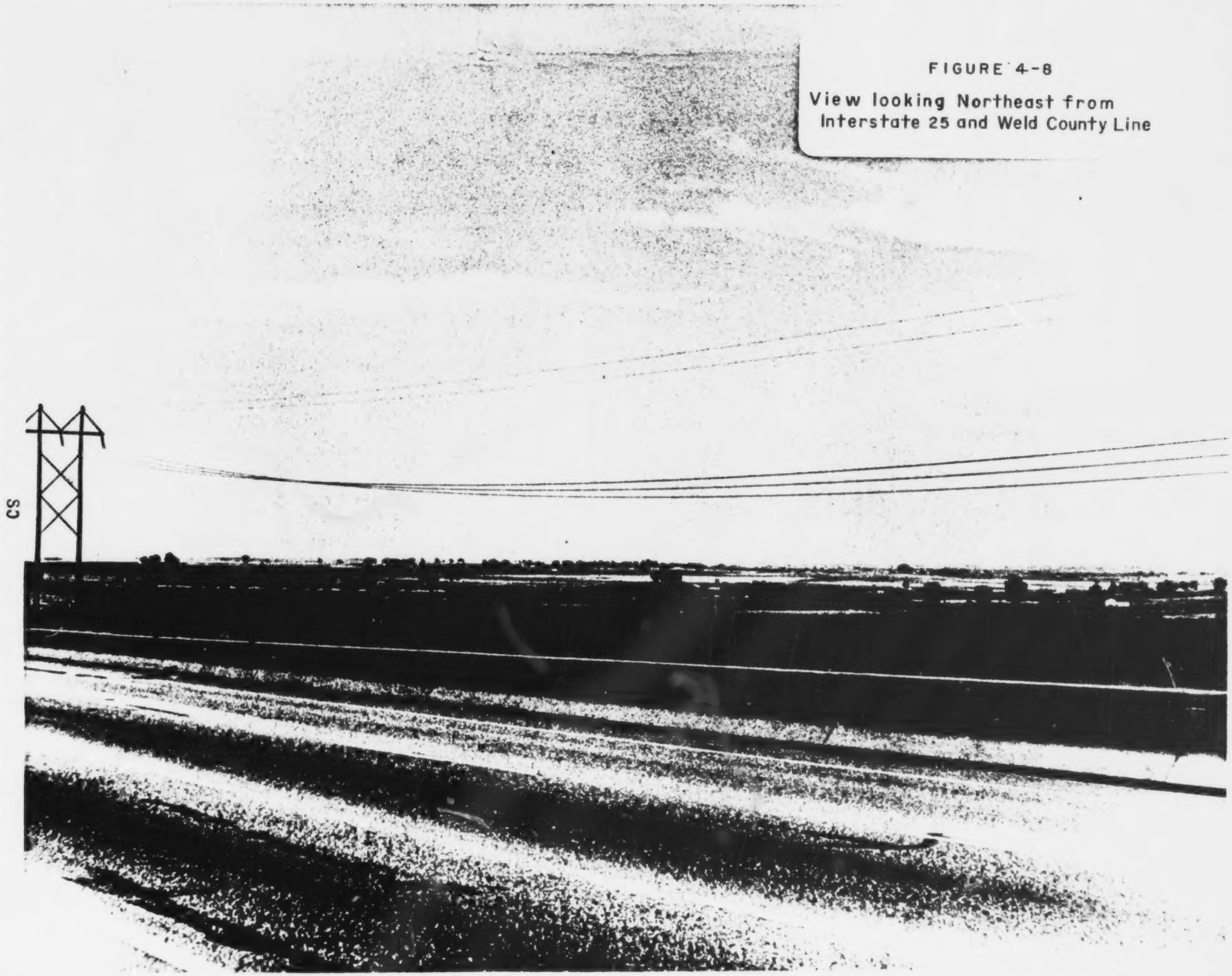
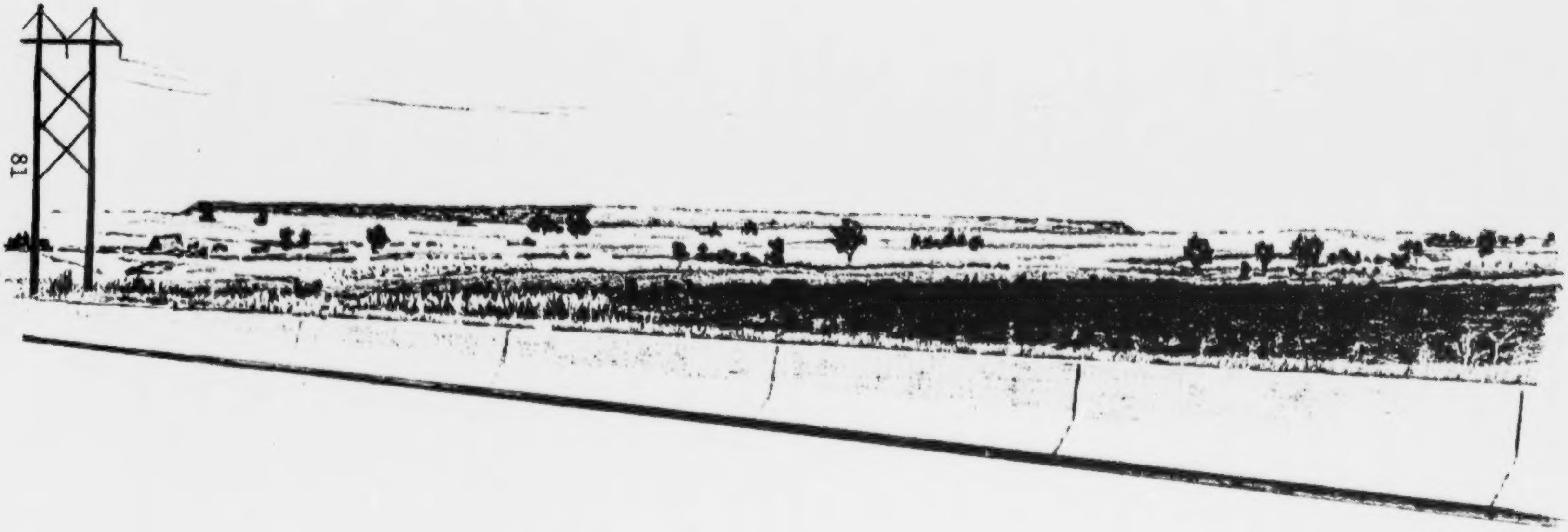


FIGURE 4-8

View looking Northeast from Interstate 25 and Weld County Line

FIGURE 4-9

Future view looking Northeast from Interstate 25 and Weld County Line



OTHER INDIRECT EFFECTS

Lining of Bull Canal

Pursuant to the four-way agreement between FRICO, Northglenn, Thornton and Westminster, the City of Thornton is to pay FRICO the sum of $3 million to line the Bull Canal system and laterals (25). The purpose of the lining is to reduce seepage losses and improve farm headgate yield.

Seepage measurements of the Bull Canal system and Big Dry Creek below Standley Lake were made jointly by Wright Water Engineers, consultants for Northglenn, and Hydro-Triad Engineers, consultants for FRICO (26). No final report has been prepared, but interim results were made available for review. The extent of lining is yet to be determined. In certain areas ground water may be flowing into the Bull Canal; and lining these portions would be detrimental.

Historically, approximately 60 percent of the Standley Lake water released in the Standley system (27) has been delivered to the farmers. Data presented by Wright Water Engineers indicates that present seepage losses in Big Dry Creek between the outlet of Standley Lake and the Bull Canal headgate are between 3 and 5 percent. In the future, as the area urbanizes, it is expected losses in Big Dry Creek will reduce to zero or even show a gain. By lining the canal system, a future total system loss of 10 percent is estimated (28).

Reduction of seepage losses may lower ground water levels and affect wells adjacent to the canal. Also, according to a study by Colorado State University for the Colorado Department of Natural Resources, improvement or irrigation efficiencies by lining may have an overall negative effect on water availability to agriculture in the South Platte Basin (29).

Ground Water Under Lands Taken Out of Production

Certain lands historically used for agriculture will, under the Northglenn plan, be taken out of production. The water rights associated with these lands will be used for augmentation by Northglenn. Removal of irrigation from land decreases the ground water recharge. The effect of this reduction by Northglenn's plan has been estimated to be very small and will not have a noticeable impact. For example, an analysis of one parcel along the South Platte indicated an estimated ground water level lowering of less than three inches as a result of removal of irrigation water. Continued removal of land from agricultural production for urbanization in the long term may have a significant effect on ground water levels.

Noxious Weeds

Under Colorado State law, counties are impowered to establish weed districts. A district is responsible for controlling noxious weeds within its jurisdiction. If a complaint comes to the administrator of the district, (generally the County extension office) the landowner is notified that steps must be taken to prevent the weeds from going to seed. If corrective measures are not taken the administrator can spray the land and charge the landowner by adding the fee to his taxes.

Concern has been expressed that Northglenn-owned agricultural land may not remain in continuous cultivation and a noxious weed problem will develop.

Western Adams County currently does not have a designated weed district that encompasses the Northglenn-owned land. Southwestern Weld County does have a weed control district that does include Northglenn owned land. Northglenn is exempt from paying taxes. Therefore, should a weed problem develop on their land the weed district would not be able to assess cost to Northglenn through the defined channels. At this time there is no enforceable policy for controlling weeds on Northglenn-owned land in either Adams or Weld County. Northglenn staff members have, however, publicly expressed their intention to control weeds on city owned lands.

Project Impacts Upon Urbanization

The Northglenn water resource management plan has significant implications for urbanization of the Denver area.

Following implementation of the plan, Northglenn will control water from the South Platte River that historically irrigated approximately 1390 acres of land. Future development of this land may be severely limited if water is not available. Should developers follow Northglenn's option to purchase agricultural water from the South Platte forms there could be a further reduction in agricultural lands as a result of the urban development. This "domino" effect, over the long-term, may have a major impact on the agricultural community around Denver.

The key to controlling this effect is in Northglenn's ability to manage their water so that as much of the land historically irrigated is maintained as such.

CHAPTER 5

STEPS TO MINIMIZE ADVERSE IMPACTS

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Farmers, ranchers, and environmentalists are allies now in their concern for the good stewardship of the nation's agricultural lands. This partnership is an immensely important one. Soil is the raw material of agriculture. We can pave it, or we can save it, knowing that whatever choice we make will profoundly influence the lives of unborn generations.

Gus Speth, Chairman
Council on Environmental Quality (1978)

CHAPTER 5

STEPS TO MINIMIZE ADVERSE EFFECTS

Significant adverse impacts that may result from the proposed plan have been identified and discussed in Chapters 3 and 4. There are two mechanisms available to EPA and the State that will insure appropriate mitigation measures are implemented by Northglenn. These mechanisms are:

1) EPA Grant Conditions; and
2) State Enforcement of NPDES Permit Requirements

Under EPA's Construction Grants Program, a grant offer contains a list of requirements that the grantee must agree to in order to receive the grant. Usually these grant conditions involve certain steps that the grantee must accomplish during the construction phase (e.g. finalization of an operation and maintenance manual, completion of an industrial cost recovery system, etc.). Withholding final grant payment is the usual mechanism that EPA uses to insure compliance with grant conditions. Grant conditions to assure continuous requirements can also be imposed by EPA effective for the design life of the project.

Effluent discharge requirements of the EPA and the State are enforceable through the National Pollution Discharge Elimination System (NPDES) permit system. This program requires that any municipality, industry, or other entity discharging into waters of the United States must do so with an approved discharge permit. The authority for the NPDES permitting system lies with EPA, but in many states, including Colorado, the administration of the system has been delegated to a state agency (in Colorado it is the State Health Department). The NPDES Permit includes appropriate limitations on the quantity, quality, and location of discharge.

During the development of this document, extensive discussion has been held with Northglenn and various affected parties regarding the identified impacts and options for minimizing these impacts. Some of the specific mechanisms that will be used to implement and enforce the mitigation procedures are being negotiated, while certain ordinances designed to reduce adverse effects have already been passed by the City of Northglenn.

Northglenn has concurred that certain impacts will require mitigation, particularly those associated with degradation of Bull Canal and the resulting public health risks. EPA has developed the following mitigating programs for the impacts identified:

Public Health Measures

Additional disinfection to reduce risks due to public contact with the wastewater

Additional disinfection for Dacono's nonpotable water supply

Tailwater Control Plan

Plan to prevent the sale of raw edible vegetables

Agriculture Reuse Manual

Commitment to use effluent for agricultural purposes

Additional measures to prevent groundwater seepage

Additional monitoring requirements beyond NPDES Permit

Resolution of Management Agency Designation

Previously required mitigating measures, including:

Urban Runoff Controls

Compliance with the State Air Quality Implementation Plan, including:

a. Limiting sewer taps
b. Limiting development to within urban service area and contiguous to existing development

Erosion Controls

Energy Conservation

Water Conservation Efforts

Radiological Emergency Response Plan

Archaeological/Historical Resources

A brief explanation of the need for these measures and the applicable grant conditions follows:

PUBLIC HEALTH - PUBLIC CONTACT WITH WASTEWATER

Farm irrigation practices and public recreation around the Bull Canal indicate that there is the potential for disease transmission through direct body contact.

The draft discharge permit from the Colorado Department of Health proposed that effluent be disinfected to a level of 1000 fecal coliforms per 100 ml. Detailed review of the medical literature (see Appendix B) indicates that public health risks are associated with 100% effluent chlorinated to 1000 fecal coliforms/100 ml. Because the project would entail uncontrolled use of effluent, meaning there would be human contact with the water during irrigation and recreation, a more stringent disinfection criteria should be applied. Therefore, the City of Northglenn has agreed to chlorinate the effluent to a level of 200 fecal coliforms per 100 ml. Whereas the City's engineer reports that the initial design included facilities to provide this level of disinfection, the operational plans did not. EPA anticipates that a dosage of 15 mg/l chlorine as projected by Northglenn will provide the necessary level of disinfection.

The EPA proposed grant condition is: "The City shall chlorinate the effluent prior to discharge to achieve a criteria of 200 fecal coliform colonies per 100 milliliters or less."

PUBLIC HEALTH - DACONO IRRIGATION SYSTEM

The Town of Dacono has a nonpotable water system which draws water from the Bull Canal and is provided, without treatment, for irrigation in certain parts of the town. The degraded quality of the water in the Bull Canal will create an unnecessary health risk within Dacono. Northglenn will resolve this problem either by substituting an alternative water source for Dacono's use in place of the Bull Canal water currently used, or installing and operating a disinfection system on the water Dacono receives from the Bull Canal. If disinfection is chosen, the system will be designed to achieve a level of disinfection acceptable to EPA which shall include a residual chlorine level of not less than 0.3 mg/l.

The EPA proposed grant condition is: "Northglenn will undertake the cost of modifications, operation and maintenance for the Dacono nonpotable water supply to insure that the nonpotable water supply for the Town of Dacono is properly disinfected to protect public health for the design life of the Northglenn project. (Alternatively at Northglenn's expense, a replacement for this system could be provided.) Northglenn shall consult with the Town of Dacono to obtain their concurrence with these plans."

PUBLIC HEALTH- TAILWATER CONTROL AT FREDERICK AND FIRESTONE

During irrigation periods, Bull Canal tailwater from lands adjacent to Frederick and Firestone flows through town streets. Northglenn has agreed with EPA to provide necessary facilities to control the tailwater so that it will not enter the Towns of Frederick or Firestone. The plan, which has been conceptually developed, will consist of three ponds that will receive the tailwater from collection ditches along the lower edges of the fields adjacent to the towns. Low dikes will reduce stormwater inflow into these ponds. Water from the ponds will be recirculated back to the irrigated land. (Should these fields be irrigated during rainfall, some diluted tailwater could flow into the streets.) According to the filings Northglenn has made with the Water Court, their position is that this water is from Standley Lake storage and impounding of this water will not create a water rights problem. EPA concludes that if the Water Court disagrees, this amount of water will have to be included in Northglenn's augmentation plan.

The proposed grant condition is: "Northglenn will provide physical measures to prevent the flow of tailwater from adjacent agricultural land into the Towns of Frederick and Firestone or any other residential area. Consultation with Frederick and Firestone on the design and location of these facilities is necessary."

PUBLIC HEALTH - FOOD CROP PRODUCTION AND GARDENS

In 1979 there were no raw edible food crops grown in the FRICO Standley Lake system. However, there is potential for these crops to be grown in the future. Also, there is potential for private gardens within the FRICO area to be irrigated with Bull Canal water.

Northglenn has agreed to a plan to prevent the public sale or distribution of raw edible food crops irrigated with its effluent. Northglenn will assist farmers in marketing the crops to buyers who will process the crops or Northglenn will otherwise compensate the farmers for economic losses to the extent of actually purchasing the vegetables if no other satisfactory solution can be found.

Regarding the possible irrigation of private gardens, Northglenn has agreed to develop an educational plan that will inform farmers of the problem and discourage direct contact with the water and its use on private gardens.

The proposed EPA grant condition is: "In the event that raw edible vegetable crops irrigated with Northglenn's wastewater are offered for sale or public distribution, Northglenn agrees to find alternative process markets for the crops or to acquire at their own expense the crop itself. Northglenn agrees to issue and reissue on an annual basis for the design life of the plant, to all shareholders of record in the Standley Lake Division of FRICO, and to all shareholders of record of any other division of FRICO to which waters from the Northglenn reservoir are diverted, an advisory concerning the constituents of the wastewater in the reservoir and a notice that such water should not be used for the irrigation of raw edible vegetable crops."

AGRICULTURAL REUSE MANUAL

The proposed project will result in delivery of reclaimed effluent and Standley Lake water to FRICO farmers. The reclaimed water is suited for the agricultural uses intended, with the exception of raw edible vegetables as noted above. There may be some minor operational changes that can or should be made by the farmers for certain crops. For example, one change that would be advised is the modification of fertilization rates to compensate for the nitrogen content in the wastewater applied. The City of Northglenn has agreed to prepare an Agricultural Reuse Manual that will provide information on such matters. This manual will be available to all farmers in the FRICO-Standley Lake Division. Projections regarding water delivery and quality would be updated monthly. A preliminary outline of the manual is given below:

A. Water Yield Projections

    1. Snow survey
    2. Standley Lake Yield

        a. Bull Canal Shares
        b. Reuse Water

B. Water Delivery Projections

    1. Crop Projections

        a. Type
        b. Acres

    2. Standley Lake

        a. Cities
        b. FRICO delivery

3. Bull Canal Reservoir
    a. Wastewater
    b. Makeup Water

C. Nutrient Delivery Projections
    1. Bull Canal Reservoir Qualities by Month
    2. Recommended Commercial Fertilizer Application Rates
    3. Crop Advisories

D. Adjustments to Delivery Projections
    1. Standley Lake Quantity and Quality
    2. Bull Reservoir Quantity and Quality
    3. Crop Advisories
    4. Field Monitoring Results

E. Distribution of Reports
    1. Agricultural Advisory Reports
    2. Water Quality Monitoring Reports

The proposed EPA grant condition is: "Northglenn will develop an Agricultural Reuse Manual (as outlined above) to provide advice to farmers of the Standley Lake Division of FRICO on the use of treated sewage effluent for crop irrigation. Periodic public reporting in the advisory notices will be provided to the FRICO Board and to anyone requesting this information."

Commitment to Use Effluent for Agricultural

Implementation of the Northglenn agricultural reuse project requires the commitment of large sums of money, both from the City and EPA. Assurance must therefore be given that the City of Northglenn can and will continue the proposed means of wastewater treatment and disposal for a reasonable period of time. The proposed plan of agricultural reuse depends on the availability of sufficnent agricultural lands to receive the effluent. While EPA concurs with Northglenn that future demand for this effluent should be adequate, in order to insure this Northglenn will develop a contingency plan whereby sufficient land under the City's control will be continuously committed to receive the effluent. This commitment can be in the form of land ownership by the City, irrigation easements, effluent sale for irrigation, or effluent lease for irrigation. The commitment is for a minimum of 20 years beyond the date of the grant award.

Northglenn purchased 1,836 acres within the Standley Lake Division incidental to water rights purchases. Fifteen hundred acres of this land are irrigated. Northglenn's engineer estimates that a minimum of 1,065 acres producing alfalfa will be sufficient to insure continuous disposal of its wastewater without adverse effects on groundwater. EPA agrees with this determination and therefore proposes to require as a grant condition that Northglenn maintain 1,100 acres under their control for effluent disposal.

The proposed EPA grant condition is: "Northglenn shall assure that sufficient land, approximately 1,100 acres, in the FRICO-Standley Lake system is under their control--through ownership, lease, or contract--for the purposes of effluent disposal. This condition is binding for the 20-year design life of the project."

Additional Measures to Prevent Groundwater Seepage

The northwest corner of the proposed reservoir may contain a fractured zone from a fault trace known to exist in the vicinity. If present, this would provide a zone of permeability potentially allowing communication of the impounded fluid with the groundwater of the immediate area. (Further analysis is provided in Chapter 4.)

Should the fracture pattern be encountered under the dike area or on the reservoir side of the excavation, there are two possible remedies: 1) move the reservoir south of the zone, or 2) design a sealing method. Additional sealing methods could include a combination of a partial membrane seal and compaction of a mixture of the local clays and proper additives to increase the plasticity in order to combine with the fractured zone material.

During the subsurface investigation of the reservoir site, many shallow holes were drilled. These penetrations in the pond area range from 23 to 60 feet below the final level of the reservoir. There are three deep well penetrations (600 to 1,500 feet) in the area of the reservoir. Two are USGS cased holes which exist near the northwest corner. The third hole, drilled by Chen and Associates, has been plugged with cement from the surface. EPA recommends that the two unsealed bore holes at these locations be sealed from about the 500 feet level to the surface.

Northglenn proposes to use on-site clay material, at least 6 inches thick, compacted to 95% density. EPA considers that a 6-inch liner may not be sufficient to insure a compacted permeability of less than 10-6 cm/sec which is the design criteria.

Where the liner is in contact with natural clays, a one foot liner would be a probable sufficient minimum. In areas where sand lenses are present, the liner should be at least two feet thick. Any open cracks or fractures which are in bedrock should be covered with a mixture of cohesionless sand and gravel to insure liner integrity after installation.

EPA proposes to require the following construction requirements: "During construction of the cut-off key for the reservoir dike, a trench will be made along the northwest boundary that will penetrate down to a competent zone in the Arapahoe formation. An examination of the exposed units will be made to determine if any fault traces cut across this portion of the reservoir. If a fault trace is located within the proposed reservoir area, either the dam will be relocated to exclude the trace, or the trace will be sealed with an impermeable liner before implacement of the clay liner. The results of these investigations and any mitigative measures must be inspected and approved by the Corps of Engineers, who will report the results to EPA.

All shallow test holes within the reservoir site that have a depth greater than 30 feet below the pond base must be plugged with concrete. Any test holes that have a depth of less than 30 feet must be back filled and compacted. The cased USGS test wells (BW-77-15B and BW-77-17B) must be pressure plugged with concrete from the bottom up to insure proper abandonment. EPA will be notified when the plugging is to take place so that a staff member can observe the plugging operation.

The thickness of the clay liner will be increased over the proposed 6" compacted seal for areas where the seal will be in direct contact with sand or sandstone. Clean claystone material must be used. In all cases the inplace claystone that will be used for a seal must be ripped up to the required depth before compacting to the six inch thick seal. In areas where claystone is not present, a supply of claystone (from stockpile) must be spread in the area and a compacted seal of at least one foot thick provided."

Additional Monitoring Requirements

Northglenn has agreed to monitor the agricultural exchange program for the design life of the project. Northglenn will collect data that relates to the potential for surface water quality degradation caused by agricultural tailwater, groundwater contamination from reservoir seepage, agricultural lands or irrigation ditches, and contamination of water and subsequently crops by heavy metals or persistent organics.

EPA proposes the following grant condition: "A monitoring program will be developed to include locations and depths of groundwater monitoring wells, locations of surface water monitoring, and procedures for monitoring crops. Pollutant parameters and monitoring frequencies must be given. Domestic groundwater supplies in the area that could be affected by the project must be identified and periodically monitored. The monitoring program shall be modified as information is developed on items such as the potential for crop contamination by toxic substances.

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(h) of the Clean Water Act. Northglenn will be required to retain all records and information resulting from the monitoring activities required by this grant condition including all records of analyses performed and calibration and maintenance of instrumentation for the design life of the project.

Northglenn must provide annual public reporting on the findings of the monitoring program. Northglenn must also identify any nonconformance with regulations concerning the level of contaminants in crops set by FDA, USDA, State agriculture and health departments and other government agencies.

In addition, EPA will provide the Larimer-Weld 208 and Weld County copies of the draft program for their review. A minimum of a 90-day review period will be given. EPA will review the Larimer-Weld 208 and Weld County comments before the monitoring program is approved. EPA shall pay no more than 50% of the federal share of the Step 3 project until the draft monitoring report is submitted to EPA. EPA shall pay no more than 80% of the federal share of the Step 3 project until the monitoring program is approved by EPA."

DESIGNATION OF MANAGEMENT AGENCY FOR THE NORTHGLENN PROJECT

The 208 Clean Water Program includes a process to identify needed treatment works, specify financial arrangements to develop these works, and set construction priorities. Each 208 area must also regulate all discharging facilities and develop policies and regulations to control all other point and nonpoint sources of pollution, identify which agencies are to implement the plan, and assess the impact of the plan. Section 208 also calls for annual recertification of water implementation controls, such as the withholding of Federal grants for constructing publicly-owned treatment plants unless there is compliance with the plan.

It has been found that capital-intensive and structural measures alone such as the construction of wastewater treatment facilities, cannot economically solve water pollution problems. Other non-structural solutions must be developed, such as the implementation of land use controls to direct population growth to areas where wastewater treatment capacity already exists or can be provided.

The Clean Water Act requires that a management system be established in each 208 plan that assigns responsibilities to specific agencies. The system must not only assure implementation of the original plan but also must allow for updating and annual recertification of the plan.

The Act further requires that responsibilities within the system be assigned according to the following four broad functions: continuing planning; management; operations; and regulation. EPA has determined that these functions are properly managed when: a) local governments and organizations control implementation of the plan wherever possible; b) general-purpose local governments are in charge wherever possible, because they are best able to integrate water quality programs with other local programs, and normally have the powers needed to deliver results; c) general-purpose local governments delegate certain powers, functions, and responsibilities through to appropriate existing agencies, so that disruptions are minimal and valuable expertise is put to use; and d) cities and counties coordinate wastewater management in the urban fringe areas where jurisdictions meet.

MANAGEMENT AGENCIES

As specified in the regulations developed for the Clean Water Program, 208 plans shall identify a specific Management Agency to implement each of the plan's programs. Each identified Management

Agency shall have adequate authority as specified under Section 208(c) of the Act to establish the agency's legal, administrative and financial authority; appropriate reporting procedures; methods for coordination with the planning agency; and a description of the specific implementation responsibilities of the agency. The Governor shall assure that each Management Agency which has regulatory responsibilities has sufficient autonomy and regulatory authority to carry out its responsibilities effectively and on time. EPA may withdraw acceptance of a Management Agency designation and request the Governor to designate a new agency, or take other corrective action, if it is determined that the effectiveness of the Management Agency is inhibited by lack of sufficient autonomy.

Management Agencies can set up contracts that delegate operational responsibility to the operators of wastewater treatment facilities. The operating agency is responsible for day-to-day operation of the facility. For example, a sanitation district could enter into an intergovernmental agreement (IGA) as an operating agency with a Management Agency (such as a city or county) that would define its specific responsibilities for implementing the facility. The sanitation district would most likely hold the effluent discharge permit for operation, be eligible to receive Federal grants to construct wastewater facilities, set its own rates, and have complete control over the operation and maintenance of the facility. The city or county, as Management Agency, would review and approve facility expansion, set construction priorities, cooperate with the sanitation district to carry out the 208 plan, and be responsible for broad areas of land use planning and nonpoint source pollution control beyond the scope of the sanitation district.

MANAGEMENT AGENCY-WELD COUNTY OR NORTHGLENN?

The City of Northglenn is located within the 208 Areawide Planning jurisdiction of the Denver Regional Council of Governments (DRCOG) and has been designated as a Management Agency under the DRCOG Plan. As such, Northglenn is eligible to receive EPA Section 201 Construction Grants funds. Northglenn will have responsiblity for any facility they construct, for issuance of bonds, and grant administration, and operation and maintenance of the facility.

In accordance with the approved Larimer-Weld 208 Plan, the continuing planning functions in Weld County are the responsibility of the Larimer-Weld Regional Council of Governments. Weld County has been designated as a Management Agency under the Larimer-Weld 208 Plan for all unincorporated areas of the county. As a Management Agency, Weld County has a vital interest in the planning, operation and management of all wastewater treatment facilities constructed within their boundaries.

The proposed Northglenn wastewater treatment and reuse facility will service only the city limits within Northglenn with an eight mile interceptor through Adams County. The plant, however, will be located in Southern Weld County, within the jurisdiction of the Larimer-Weld Regional Council of Governments' 208 Areawide Planning Region. This situation is unique in Colorado and there have not been any precedents established for designation of the Management Agency under these circumstances. There are four alternative methods of designation:

1) Weld County would be the Management Agency and grant recipient. Northglenn is the operating agency under the Larimer-Weld 208 Plan:

2) Weld County would be the Management Agency. Northglenn would be the operating agency and grant recipient;

3) Both Northglenn and Weld County would share Management Agency responsibility with Northglenn as operating agency and grant recipient:

4) Northglenn would be the sole Management Agency and grant recipient. These alternatives are further identified:

1) Weld County would be identified as a Management Agency with Northglenn as an Operating Agency. Weld County would receive the grant and would pass through the funds and operating responsibilities to Northglenn as defined in an agreed upon intergovernmental agreement (IGA). Thus, Northglenn would be eligible to set its own rates and have control over the daily operation of the facility. Weld County would have the power to review and approve or deny facility expansion, set construction priorities, cooperate with Northglenn to carry out the respective 208 plans, and be responsible for broad areas of land use planning and nonpoint source pollution control beyond the scope of Northglenn;

2) Same as above except Northglenn would be the direct recipient of all Federal construction grants for their wastewater treatment facility;

3) Both Northglenn and Weld County would act as Management Agencies as they have been so designated under their respective 208 planning agencies. Northglenn would also be identified as the Operating Agency under the Larimer-Weld 208. The sharing of Management Agency responsibility and the designation of Northglenn as the Operating Agency would have to be specifically defined in an IGA. Under this arrangement, Northglenn would be identified as the grant recipient and would be responsible for operating and maintaining the wastewater facility in accordance with provision in the IGA:

4) Northglenn would be identified as sole Management Agency and thus would directly receive any Federal construction grant funds. Northglenn has been identified as a management agency

under the Denver Regional 208 Plan because the service area is located in Adams County which is under the jurisdiction of DRCOG. If this alternative were chosen there would be no need for an IGA as Northglenn would be solely responsible for plant operation, expansion or land use changes.

EPA concludes that the requirements of both 208 plans (which have received State certification and EPA approval) must be met, preferably through a formal Intergovernmental Agreement (IGA). Management Agency certification for both Northglenn and Weld County and execution of a bilateral IGA between Northglenn and Weld County will serve to notify the responsible areawide agencies, State agencies, and EPA of conformance with the 208 Plans. Therefore, EPA prefers alternative 3 which establishes the sharing of Management Agency responsibility. Consequently, EPA proposes to require the development of the IGA as a condition before receiving the final payment of the grant.

The Statewide 208 Executive Committee, with the assistance of the Attorney General's office, is investigating the consequences and legal implications of the various options of the Management Agency issue. The Committee has taken a lead role in the past in developing management systems in 208 Plans, and is now assisting in the resolution of this issue.

CONDITIONS OF THE INTERGOVERNMENTAL AGREEMENT

The following issues are recommended by EPA as items to be included in an IGA between Weld County and Northglenn:

1. Fecal Coliform Limit

   Development of a desirable level of disinfection to reduce public health risks associated with direct contact with the effluent. EPA will require, as a grant condition, that the effluent not exceed 200 fecal colonies per 100 ml and prefers that this limit also be specified in the IGA.

2. Sale and Distribution of Raw Edible Crops

   Require that plans be developed to prevent the sale and/or distribution of raw edible vegetables grown with Northglenn effluent. This items would establish that Northglenn bears full responsibility for any losses incurred.

3. Advisory for Agricultural Reuse

   Develop detailed agricultural reuse manual and educational plan to advise farmers on the use of the effluent for all crops or private gardens using the Bull Canal system.

4. Replacement or Disinfection of Dacono Nonpotable Water System

Specify the method of complete disinfection to provide a residual chlorine level or replacement of the nonpotable water system for the Town of Dacono. Advise that Dacono is properly represented and advised on the solution to this problem.

5. Tailwater Control

Development of physical measures to prevent the flow of tailwaters from adjacent agricultural land into the Towns of Firestone and Frederick, or any other residential area.

Assurance that Weld County and the communities of Firestone and Frederick are properly represented and advised on the solutions to this problem.

6. Land Use Authority

The IGA should establish: a) Weld County's authority for zoning and land use planning in the area surrounding the treatment/reuse facility; b) Northglenn's authority for taps into the project interceptor; and c) Northglenn's authority for plant expansion. (Northglenn would not require Weld County approval for expansion within the boundaries of Northglenn.)

7. Sludge Disposal

Northglenn would be creating sludge waste for disposal within the LWRCOG 208 plan area and therefore must comply with appropriate regulatory requirements in the disposition of such wastes. Northglenn plans to dispose of sludge on agricultural land in Weld County and Adams County.

8. Additional Monitoring Requirements

EPA proposes to require, as a grant condition, a monitoring plan of the agricultural exchange program for the design life of the project. Northglenn will collect data that relates to the potential for surface water quality degradation caused by agricultural tailwater, groundwater contamination from effluent seepage, agricultural lands or irrigation ditches, and contamination of water and subsequently crops from materials such as heavy metals or persistent organics.

The monitoring program would be developed by Northglenn. EPA would provide the Larimer-Weld 208 and Weld County copies of the draft program for their review. A 90-day review period could be established and EPA would review the Larimer-Weld 208 and Weld County comments before the monitoring program is approved.

Northglenn should provide annual public reporting on the findings of the monitoring program. Northglenn must identify any nonconformance with regulations of the level of contaminants in crops set by FDA, USDA, State agricultural and health departments and other governmental agencies.

The IGA should consider the possibility of the Weld County Health Department processing some of these samples as a maethod of independent review. Northglenn should then reimburse Weld County for such expenses. Finally, assurances should be provided for the long-term financial liability of Northglenn for this water quality monitoring program.

9. Protection of Groundwater Quality

Plans would need to be established to deal with possible groundwater pollution. Such plans should consider the groundwater monitoring program and a contingency plan to replace, at Northglenn's expense, the supply of water to residents presently dependent upon groundwater, if contamination is caused by this facility.

10. Limits on New Interceptors

A tap restriction prohibiting Northglenn from building any interceptors to the facility without prior Weld County approval should be included.

EPA proposes the following grant condition: "The City of Northglenn and Weld County shall share responsibilities as Management Agencies under their respective 208 Water Quality Plans. Designation of said responsibilities shall be incorporated into an Intergovernmental Agreement following as a minimum EPA recommendation as outlined above. EPA shall pay no more than 50% of the federal share of the Step 3 project until the draft Intergovernmental Agreement is submitted to EPA. EPA shall pay no more than 80% of the federal share of the Step 3 project until the Intergovernmental Agreement is signed by the two parties and approved by EPA and the State."

PREVIOUSLY REQUIRED MITIGATING MEASURES

When EPA issued its initial environmental assessment on the Northglenn facility in September, 1978, several measures designed to reduce adverse impacts were identified. All Denver area communities which request EPA sewage funds must comply with EPA provisions as developed in the Denver Overview EIS. (See Final Action on the Denver Regional Environmental Impact Statement for Wastewater Facilities and the Clean Water Program, August, 1978). For the City of Northglenn these conditions include:

Urban Runoff Controls

Compliance with the State Air Quality Implementation Plan, including:

a. Limiting sewer taps, and
b. Limiting development to within the urban service area and contiguous to existing development.

Erosion Controls

Energy Conservation

Water Conservation Efforts

Radiological Emergency Response Plan

Archaeological/Cultural Resources

With certain limited exceptions, EPA has accepted Northglenn's efforts to fulfill these conditions. The current status of these efforts is:

Urban Runoff Controls

The Denver Regional Council of Governments recommended in the Clean Water Plan that urban runoff pollution be controlled by nonstructural controls such as pollution control ordinances (see Denver Overview Final EIS, Volume 1, page 33). The use of structural pollution controls to collect and treat urban runoff was believed to be too expensive to justify at this time. Accordingly, EPA determined that prior to granting funds for construction or expansion of wastewater facilities, the general-purpose governments within the proposed service area must show progress, in the form of ordinances adopted or recent efforts taken, towards implementing the nonpoint source controls recommended by the Clan Water Plan. Northglenn has met this requirement with respect to urban runoff control by adopting a new ordinance to their municipal code entitled "City Urban Runoff Drainage Ordinance".

Specific water quality purposes of this ordinance (Section 16-13 of the Municipal Code of Northglenn) include:

a) A coordinated program of creating upstream ponding for temporary detention of storm runoff waters;

b) Encouragement and facilitation of urban water resources management techniques, including detention of storm runoff, minimization of the need to construct storm sewers, reduction of pollution, and the enhancement of the environment.

The Urban Runoff Management Plan, based on engineering studies, indicates the location of all drainage facilities in the City, including those facilities which presently exist and those which are determined to be needed in the future.

The facilities shown on the plan include all major drainage ways which directly or indirectly affect drainage within the City, and all conduits, channels, natural drainage courses, retention reservoirs, easements, culverts, bridges and other facilities which are required to provide for the drainage and control of surface waters within the basins of the drainage ways and to carry such waters to designated points of outflow or discharge.

Maximum citizen participation during all phases of the implementation of the storm drainage and flood control regulations is encouraged.

To insure citizen participation on actual construction projects, any time a project is proposed by the City to implement the Urban Runoff Management Plan, the City administration will hold a public hearing in the neighborhood where the project is to be constructed. The Planning Board and City Council shall hold public hearings prior to construction of the project.

EPA accepts this ordinance as written as suitable to meet the requirements of an urban runoff control plan. Accordingly, EPA proposes the following grant condition:

> "Northglenn shall maintain for the design life of the project an urban runoff control plan similar to the provision contained in Ordinance No. 531 entitled "Urban Runoff Management Plan."

Air Quality

The funding of wastewater treatment and collection facilities that involve the addition of capacity to serve future population growth should be done in a manner encouraging the implementation of measures to reduce the existing air pollution problem. Population growth will occur in the Denver metropolitan area. Unless strategies to reduce air pollution (principally from automobiles) are implemented, air quality will not significantly improve. Funding of additional wastewater facilities does not cause air pollution, but it does support growth, both economically and locationally, by providing readily available services for sewage treatment and reducing development costs. Therefore, EPA believes that funds should be made available only where reasonable actions are being taken to deal with the air quality impacts of growth.

Accordingly, EPA requires:

1. A commitment from the elected officials of the local governments which are to be served by the proposed wastewater treatment facility to:
    a. Implement air pollution control measures considered reasonable for their area from the general list of measures outlined in Appendix C of the Colorado State Air Quality Implementation Plan.
    b. Participate in the process established by the State of Colorado and the Denver Regional Council of Governments to revise the Denver element of the State Air Quality Implementation Plan.

c. Support the implementation of the Denver element of the State Air Quality Implementation Plan as approved by EPA.

2. Design wastewater facilities, based on DRCOG population projections (or as revised during the State Air Quality Implementation Process) with capacity increases staged in accordance with the April 25, 1978 regulations.

3. The grant applicant (in conjunction with local jurisdictions) must develop and implement a sewer tap program which determines annually the number of taps available for new residential development and is consistent with the DRCOG population forecasts for 1980, 1990, and 2000.

4. Development which will be served by the additional capacity must be within the adopted regional urban service area boundaries and contiguous to existing development as stated in DRCOG's Regional Plan Policies. EPA requires evidence that local governments within the service area are promoting contiguous development through zoning actions, building permit approvals and tap allocations.

Northglenn will meet these requirements through the following provisions:

a. A resolution adopted by the City Council indicating compliance with all measures developed in the Denver element of the State Air Quality Implementation Plan.

b. An ordinance limiting the number of taps available on an annual basis.

c. Ordinances prohibiting new taps along the proposed new interceptor.

These provisions are further explained:

On November 16, 1978, Northglenn adopted Resolution No. 78-92 which states in part that:

> "The City shall develop, implement and strictly enforce a comprehensive set of ordinances, policies and programs designed to produce and maintain ambient air quality standards;
>
> The City shall actively participate in the planning, research, and development of the Denver element of the State Air Quality Implementation Plan;
>
> The City shall cooperate to the fullest extent possible with the Denver Regional Council of Governments in the development of such a plan; and
>
> The City shall upon approval of such plan by the Environmental Protection Agency, enact and enforce an air quality ordinance for the purpose of ensuring compliance with the plan and with the goals of the Clean Air Act, as amended in 1977."

The City of Northglenn adopted, on December 21, 1978, an ordinance (Number 529) providing for a sewer tap program which annually determines the number of taps available for new residential development. The ordinance also provides a penalty for violation.

The ordinance specifies that it is unlawful for any person to make any connection to the City's sanitary sewer system without first obtaining the City Manager's approval of such connection. The ordinance indicates that the City Manager shall grant approval of applications for residential connections to the City's sanitary sewer system consistent with and not to exceed the following schedule:

YEAR	MAXIMUM ANNUAL RESIDENTIAL	CUMULATIVE RESIDENTIAL
1978	430	430
1979	430	860
1980	431	1291
1981	431	1722
1982	431	2153
1983	431	2584
1984	431	3015
1985	431	3446

Any connections not used in any one year may be added to the next succeeding year's allowable number of connections, except that in no year shall the total of all connections permitted exceed the cumulative total allowable for that year.

Any person violating the terms of this ordinance shall, upon conviction, be guilty of a misdemeanor and shall be subject to a fine not to exceed Three Hundred ($300.00) dollars, or imprisonment in the City or County jail not to exceed ninety (90) days, or both such fine and imprisonment.

In order that the proposed new interceptor will not unduly interfere with the adopted land use policies of Thornton and Adams County, and in order to provide for contiguous development, Northglenn has agreed to an EPA condition that prevents connections to the Northglenn interceptor. By City Ordinance adopted December 21, 1978, Northglenn amended its municipal code to include:

> "Section 16-11-5. Prohibition Against Connections to The Northglenn Interceptor. It is unlawful for any person to directly or indirectly connect any collection system, interceptor, pump station, or other means of conveying sewage, to the Northglenn Interceptor as set forth on the map filed in the office of the Director of Public Works, for that section of the interceptor which is located outside of the City's corporate boundaries, and running from the corporate boundaries to the sewage treatment facility, except the area between 120th Avenue and 136th Avenue, which exceptions are subject to approval by both the City and the United States Environmental Protection Agency."

Any person violating the terms of this ordinance shall be guilty of a misdemeanor and subject, upon conviction, to a fine not to exceed Three Hundred ($300.00) Dollars, or by imprisonment in the City or County jail not to exceed ninety (90) days, or by both such fine and imprisonment."

EPA accepts these actions of the City of Northglenn to be in compliance with agency policy to minimize air quality impacts within the Denver urban area. Accordingly, EPA proposes the following grant condition:

"Northglenn shall execute those items specified in City Resolution Number 78-94 regarding its intention to implement and enforce compliance with the provisions of the Denver element of the State Air Quality Implementation Plan. Northglenn shall maintain an ordinance providing for sewer tap limits as defined in Ordinance Number 529 adopted December 21, 1978. The City shall maintain a prohibition against connections to the Northglenn interceptor as specified in Section 16-11-5 of the municipal code for the design life of the project. In addition, the Regional Administrator may withhold, condition, or restrict the Step 3 grant in the event that he determines that the provisions of Section 316(b) of the Clean Air Act of 1977 have been met."

Erosion Control

Northglenn had agreed to implement erosion control measures by passing City Resolution Number 78-102, adopted December 21, 1978. The resolution called for adoption of an erosion control ordinance by June, 1979. Northglenn has failed to implement this provision to date. Accordingly, EPA will require Northglenn to adopt measures to limit erosion and to control sediment prior to grant award. Northglenn is hereby notified to prepare an ordinance specifying erosion controls and to follow: Guide for Erosion and Sediment Control in Urbanizing Areas of Colorado: Interim Guidance, prepared by the U.S. Department of Agriculture, Soil Conservation Service, Denver, Colorado, 1977. EPA will not award a Step 3 grant until the grantee has adopted appropriate ordinances or requirements to implement the erosion and sediment control requirements included in the DRCOG 208 Clean Water Plan.

Energy Conservation

EPA requires that during the planning or design of any wastewater treatment works, the consideration of solar energy technology and energy conservation techniques must be demonstrated by showing that energy requirements, particularly for natural gas, have been reduced as much as possible.

Northglenn has fulfilled this requirement primarily by selecting aerated lagoons which are an energy efficient method of treatment. The agriculture reuse system reduces energy requirements by continuing to produce agricultural products near the Denver area which will reduce transportation costs and by providing nutrient recycling which will reduce the use of inorganic fertilizers produced with natural gas.

The Northglenn project includes a control building at the aerated lagoon treatment plant. The building design has incorporated passive solar design features including window positioning and partial burying to conserve heat. The building design also has included a heat recovery system that will heat the building with heat recovered from aeration blowers, by utilizing a heat pump.

Therefore, EPA concludes no further measures are necessary regarding energy conservation.

Water Conservation

EPA regulations for cost effective analyses specify that fair consideration be made for reducing wastewater flow (generally called water conservation) for communities over 10,000 population discharging wastewater greater than 70 gallons per capita per day (gpcd). (For the purpose of calculating average per capita use, industrial flow and groundwater infiltration are excluded.) Under these circumstances, the grantee must use the estimated future reduction in flows for wastewater facility design.

The current average potable water use in Northglenn has been measured at 144 gpcd with an average of 91 gpcd returning as wastewater flow. Of the total wastewater flow, 18 gpcd are attributed to either industrial sources or groundwater infiltration, leaving an estimated 73 gpcd of residential wastewater flow. Because Northglenn's current use is so close to the 70 gpcd criteria, EPA determined the formal cost-effective analysis of wastewater flow to be unnecessary, especially since Northglenn's plan includes several methods for reducing water use. The proposed methods include mandatory water saving devices for new construction and remodeling, outdoor irrigation reduction measures, and economic incentives for new taps to minimize water use.

Northglenn has adopted Ordinance Number 555 establishing fees and charges for connections to the water and sewer utility system which bases charges on estimated use. The graduated fee schedule establishes additional costs for each 5,000 square feet of irrigated lawn with lower fees established if a resident installs drip irrigation or automatically timed spray irrigation.

In addition, Northglenn is also in the process of adopting a city ordinance to specifically promote water conservation. This recommended ordinance, entitled "Water Conservation and Plumbing Code of 1979," specifies that:

> "The Director of Natural Resources shall develop within 120 days of passage of this ordinance, an inventory list of commercially available fixtures designed to achieve conservation of water in an economically feasible manner. The inventory list shall include, but not be limited to the following:
>
> A. Indoor Criteria - Construction and Remodeling
>
> 1. Low flow toilets using less than 3.5 gallons per flush.
> 2. Air pressure toilets.
> 3. Shallow drip toilets.
> 4. Pressure reducing showerheads or water pressure reducing valves.
> 5. Instant mixing thermostatic valve or similar device reducing time for tap outflow to reach desired hot water temperature.
> 6. Faucet aerators.
> 7. Self-regulating automatic shutoff faucets.
> 8. Dye table testing for toilet tank leaks.
> 9. Water conserving dishwashers.
> 10. Water conserving clothes washing machines.
> 11. Use of air cooled air conditioners.
>
> B. Outdoor Criteria - Construction, Remodeling and Landscaping
>
> 1. Landscaping - For grassy areas, exclusive use of buffalo grass, western wheatgrass, crested wheatgrass, blue gramma, a mix of these or other grasses, or a comparable grass which will have the effect of minimizing the consumptive use of water applied to such grass or grasses for irrigation.

For non-grassy, non-food producing areas, use of plants native to Colorado or states bordering Colorado.

2. Irrigation - In all cases in which the economic character of the development proposal is such that non-indigenous species of grasses, shrubs and trees are to be utilized in the landscaping plan, provision shall be made in the development proposal for an irrigating system which incorporates only equipment of the most water conserving type commercially available at the time the proposal is submitted for approval. At a minimum, irrigation systems shall:

    a) be equipped with a time activated automatic shutoff,

    b) be equipped with sprinkler heads of a type which provide the most uniform coverage feasible, and maximum feasible droplet size to reduce evaporation and wind disturbance of coverage,

    c) where slope of the proposed development so requires, irrigation systems shall be designed to control flow for the purpose of reducing runoff and increasing ground absorption.

3. Drainage Management - All development proposals shall include a drainage management plant incorporating at a minimum:

    a) collection of runoff from roofs, patios, sidewalks, driveways, streets and alleys.

    b) application or diversion of the water collected through 3(a) to the irrigation of landscaping vegetation within the development or adjoining developed land.

    c) the design, construction and operation of detention facilities shall conform to the requirements of the Division Engineer in accordance with the statutes of the State.

4. Swimming Pools - All swimming pools, both new and existing, shall be equipped with blanket pool covers which shall be employed whenever the pool is not in use."

Accordingly, EPA proposes to impose a grant condition which states: "Northglenn shall develop a water conservation policy similar to their proposed ordinance entitled "Water Conservation and Plumbing Code of 1979," which encourages further reductions in wastewater flows. Said ordinance with amendments shall remain in effect for the design life of the project."

Radiological Emergency Response Plan

The City of Northglenn is located just beyond the area known as the Category II area (10 miles radius) of the Rocky Flats Plant. The proposed water supply system, however, includes Standley Lake and Woman Creek which are inside the Category I area (5 mile radius). Accordingly, EPA has determined Northglenn must comply with the provisions of the proposed Radiological Emergency Response Plan for Rocky Flats.

State officials have been waiting for several months to distribute this pamphlet telling those who live within 10 miles of the Rocky Flats nuclear weapons plant what to do in case of an emergency there. Its distribution, however, has been stalled by two obstacles. First, state and federal officials can't agree on what might be the worstcase accident that could happen at the plant, or what precautions should be taken. Second, a test of the state's Disaster Emergency Services Agency revealed that the state would find it difficult to carry out the emergency response outlined in the plan. The current draft is now in the Governor's office while officials attempt to improve the state's emergency response plan.

Providing these steps are completed, Northglenn can implement the recommendations of this plan that are applicable to their area. EPA recognizes it cannot currently impose a condition on Northglenn which is dependent upon other agency actions outside the city's control. Therefore, with respect to this plan, EPA proposes to apply as a grant condition: "The grantee shall develop a notification procedure consisting of distributing and redistributing annually, a notice yet to be developed, approved, and furnished by the State, for notifying existing homeowners within the Category II area as defined by the State Radiological Emergency Response Plan. The grantee shall provide EPA with a copy of the procedures, as adopted prior to receiving a Step 3 grant from EPA, provided the State and the Department of Energy have completed this plan at that time. If and when the plan is formally approved at a later date, Northglenn shall then adopt and maintain for the project design life, those procedures necessary for the City of Northglenn as specified in the Plan."

Archaeological/Historical Resources

As noted in Appendix A, the survey of archaeological/historical resources conducted of the proposed interceptor route and reservoir site identified a possible area of interest consisting of a turn-of-the-century dump along the interceptor route. No other significant historical resources were identified. Northglenn discussed the situation with the State Historic Preservation Officer and has agreed to modify the interceptor route to avoid this area. EPA proposes to apply the following grant condition: "If archaeological or cultural artifacts are unearthed, construction will be halted and the State Historic Preservation Officer will be consulted immediately. Accommodations will then be made as necessary for excavation and/or assessment of uncovered archaeological resources."

CHAPTER 6

PUBLIC PARTICIPATION AND COORDINATION

"The open society, the unrestricted access to knowledge, the unplanned and uninhibited association of men for its furtherance--these are what may make a vast, complex, ever growing, ever changing, ever more specialized and expert technological world, nevertheless a world of human community."

J. Robert Oppenheimer
Science and the Common Understanding (1953)

CHAPTER 6

PUBLIC PARTICIPATION AND COORDINATION

During preparation of this document several meetings have been held to inform the public and solicit public comment. These meetings have involved the public at large, vested interest groups, and local and regional governmental entities. At the outset of the project a discussion panel was established. The panel met officially in two public meetings and other informational meetings. Participants on the advisory panel are listed below in Table 6-1. The first public meeting was held August 30, 1979 and concentrated on public health risks and direct impacts of the facilities. The second public meeting on September 13, 1979, discussed the flow augmentation plan and impacts on agriculture.

The following is a chronology of the public meetings held, and a summary of the issues discussed during these meetings.

July 19, 1979 - EPA and Weld County citizens met in Frederick, Colorado. EPA staff were shown problem areas including Dacono's reservoir tailwater flow near Frederick and asked to protect canal water quality for drinking water use. EPA has determined that it is necessary to require chlorination of Dacono's nonpotable water supply, however, the canal need not be protected as a drinking water supply source (see EPA's proposed decision in Chapter 1).

August 15, 1979-EPA and Consolidated Ditch met in Brighton, Colorado. The meeting centered around Northglenn's preliminary flow augmentation plan, how it may effect South Platte water right and South Platte agriculture. Key issues discussed included: tributary ground water reductions; nitrogen concentrations; effects on sugar beets, barley, and livestock; noxious weeds; and impacts to the South Platte. These issues are discussed under "Agricultural Issues" in Chapter 3.

August 28, 1979-EPA, State Health Department and Northglenn met in Denver, Colorado. The purpose of this meeting was to discuss grant eligibility, proposed permit requirements and Northglenn's commitment to agriculture reuse. Key conclusion of this meeting was that Northglenn owns sufficient land to ensure an agricultural commitment. The issue of meeting a 200/100 ml fecal coliform limit was discussed and Northglenn has now agreed to meet this criterion(see Chapter 5 on Steps to Minimize Adverse Impacts).

August 30, 1979-Citizens Discussion Panel met in Frederick, Colorado. Discussion at this meeting focused on public health and direct impacts of the facilities. It was concluded that significant public health risks are associated with the plan as proposed. A permit requirement of 200/100 ml fecal coliform could reduce health risks and provide a better degree of protection. Panel members discussed the following issues before the session was opened to questions and answers from the floor:

Issue: Northglenn expressed a fear of setting precedent which will impact all waters of the State.

Response: There are similar circumstances in the State where secondary treated effluent is used for irrigated agriculture especially when low stream conditions exist. However, under the Northglenn plan discharge of treated effluent without any dilution from another source is part of the day-to-day operational plan. EPA concludes that additional measures are necessary for this unique situation. Both EPA and the State of Colorado are considering establishing uniform permit requirements for uncontrolled agricultural reuse.

Issue: There is a lack of downstream monitoring to insure compliance.

Response: Additional monitoring will be done by Northglenn in order to understand the effects of the plant operation (See Chapter 5 on "Additional Monitoring Requirements").

Issue: Treatment process will not be able to control pathogens.

Response: Die-off of pathogens in lagoon systems is excellent. (See Literature Review of Public Health Risks in Appendix B).

Issue: Hazards associated with a treatment plant upset during peak irrigation season.

Response: Northglenn's operational plan must provide for this contingency.

Issue: Effect of nutrients on fertilizer requirements and ground water.

Response: (See both the Agricultural Reuse Manual requirement and Additional Monitoring Requirements in Chapter 5).

Issue: Panel members expressed concern over lack of advanced information.

Response: EPA has tried to accomodate all requests for information as the information becomes available. EPA has placed all public materials concerning the Northglenn Project on reserve in EPA's library (See the Index and Reference section).

Issue: The plan degrades Bull Canal water quality thus eliminating it as a future water supply source.

Response: This is correct, see analysis on this issue in Chapter 3.

Issue: Complaint issued that treatment process operation has not been evaluated.

Response: EPA intends to complete further analysis of the treatment process during preparation of the final EIS.

Issue: Public health risks of Bull Canal tailwater in Frederick and Firestone.

Response: A tailwater control plan is required (See the proposed EPA decision in Chapter 1).

Issue: Stability and lining of Bull Canal reservoir.

Response: EPA will require additional construction measures to reduce seepage (See Chapter 5).

Questions from the floor addressed the following topics:

Issue: Does the treatment process have the ability to meet the BOD and suspended solids limit of 30-30 (BOD-SS)?

Response: Northglenn must comply with provisions under the State issued NPDES permit to meet these limits. The proposed treatment method is unique in using controls on alkalinity to meet these standards. EPA will conduct further analysis of the treatment process and report on that analysis for the final EIS.

Issue: Can FRICO farmers be restricted in the crops they choose to grow and were cropping practices studied?

Response: Cropping practices were studied (See Agriculture in the Study Area in Appendix A). Farmers are not restricted in crop selection, however, Northglenn must prevent the distribution of raw edible crops grown with their effluent. (See Public Health Measures in Chapter 5.)

Issue: Why are there no EPA or State studies to develop viral correlations to coliform counts ?

Response: Studies on the relationships of viral concentrations to coliform bacteria have been conducted. However, present data are inconclusive to establish any meaningful correlations.

Issue: What effect will industrial wastes have on water quality and treatment processes?

Response: See discussion on Heavy Metals and Industrial Pretreatment Requirements in Chapter 3.

Issue: Is there an effect from nitrates on Ft. Lupton's future water supply?

Response: No, see Use of Canal Water for Drinking Water Supply.

Issue: Will storage eliminate virus?

Response: No, but pathogens do die-off during storage, see Appendix B.

Issue: Will quality of water restrict farmers in irrigation practices?

Response: Changes in some irrigation practices will be necessary See outline of Agricultural Reuse Manual in Chapter 5.

Issue: Northglenn will have to develop physical measures for tailwater in Frederick and Firestone and irrigation water in Dacono.

Response: Yes, see EPA's proposed decision in Chapter 1.

Issue: Odor will create a problem in the surrounding area.

Response: Possibly, see analysis of odor problems in Chapter 4.

Issue: Treatment facility will not work as designed.

Response: See previous answer on this issue.

Issue: The potential for cross-contamination of vegetables.

Response: EPA believes the potential for cross-contamination of vegetables does not create a health risk. Vegetables irrigated with effluent are not to be sold commercially and Northglenn's operational plans require a mode for educating farmers of appropriate precautionary measures for private use.

Issue: Can Denver Metro handle Northglenn until 1985?

Response: Denver Metro must expand its facilities by 1985, see EPA funding criteria in Chapter 4.

Issue: Who is responsible for enforcement of standards?

Response: The Colorado State Health Department.

Issue: Who controls stopping discharge if water quality is not suited for agriculture?

Response: EPA and Colorado State Health Department.

Issue: Is there going to be ground water pollution under canals?

Response: The Bull Canal will be lined by FRICO, see section on "Indirect Effects" in Chapter 4.

Issue: Will EPA address potential for canals to be used as potable water supplies?

Response: EPA has determined such protection is unwarranted.

Issue: If Frederick were using the water as a domestic source would there be a different determination as to protecting this supply.

Response: Yes, if a water source is currently used for any purpose EPA is required to protect water quality for that use.

Issue: FRICO shareholders have not approved plan by a majority.

Response: The Board of FRICO has approved this plan.

Issue: The plan results in a loss of taxable income to Counties, will impact local communities and is not consistent with Weld County Land Use Plan.

Response: Tax loss is quantified in Chapter 4. The Weld County Planning Commission has approved the treatment plant site.

Issue: The plan is not consistent with 208 plans, and conflict in designating a Management Agency.

Response: See discussion on Management Agency designation in Chapter 5.

Issue: Water lost from South Platte is a concern which may be prevented if alternative water supplies besides Standley Lake are evaluated. Project should be held up until Water Court decision is made.

Response: EPA believes Water Court approval is likely with changes, see Proposed EPA Decision.

Issue: Frederick's future water supply was discussed as to how they intend to meet their requirement.

Response: EPA advises Frederick to seek an alternative water supply other than the Bull Canal.

Issue: Status of Grand Jury investigation - what is it?

Response: See Section on Summary of Filed Litigation, Appendix D-5.

Issue: What happens if Water Court requires more augmentation water to implement plan?

Response: Then Northglenn must secure such water flows.

Issue: What water supply alternatives were evaluated?

Response: See Water Supply Alternatives in Chapter 4.

Issue: Can the concept of the augmentation plan be approved by the Water Court?

Response: This must be resolved by the Water Court.

Issue: If ground water is contaminated in wells near the reservoir will Northglenn provide a new water supply?

Response: If such contamination is a result of Northglenn's facility then presumably Northglenn would have to replace these wells. EPA plans to require additional construction requirements to further assure such a situation does not occur, see Additional Measures to prevent ground water seepages in Chapter 5.

September 7, 1979 - EPA and Citizens Discussion Panel meeting in Denver, Colorado. The purpose of this meeting was to discuss with the panel issues of the plan and provide additional information to the panel members.

September 11, 1979 - EPA and State coordinator 208 meet in Loveland, Colorado. Primary discussion related to Management Agency designation, See Chapter 5.

September 13, 1979 - Citizens Discussion Panel met in Northglenn, Colorado. Discussion during this meeting focused on the flow augmentation plan and agricultural impacts. Several of the issues discussed during this meeting were identified in the first Panel meeting. The new issues and comments of this meeting are summarized below.

Issue: The flow augmentation plan appears to be viable but this determination will be made in the Water Court.

Response: Correct, see EPA proposed decision regarding protection of vested water rights in Chapter 1.

Issue: There will not be any impact to sugar beets or barley in FRICO.

Response: Proper management can prevent any problem, see discussion on agriculture in Chapter 3.

Issue: Concern was expressed about basing water supply on deep wells. Can they be used only in dry years?

Response: See alternative water supply options in Chapter 4.

Issue: The plan protects agriculture, does not impact ground water in the South Platte valley, Northglenn will develop plans to protect public health.

Response: No response necessary.

Issue: Green corn with high nitrate concentration will be toxic to cattle. How will they be protected?

Response: Proper drying of silage corn prevents this problem. See discussion on water quality in Chapter 4.

Issue: Energy may be saved by using fertilizer benefit of wastewater to reduce purchase of chemical fertilizer.

Response: Some energy costs will be reduced by recycling nutrients.

Issue: Industry will require pretreatment prior to treatment at facility.

Response: Correct, see discsusion on this issue in Chapter 3.

Issue: Advisory Panel is supposed to have technical advisory group.

Response: Not necessarily, EPA believes the Panel provided valuable recommendations which are reflected in EPA's decision.

Issue: Federal money should help provide additional storage of Colorado water.

Response: Not related to EPA mission.

Issue: Big Thompson water for Frederick is too expensive.

Response: Frederick needs to find the least cost solution to their needs.

Issue: Agricultural impacts are - shifting agricultural water, drying up agricultural land, creating salt problem in soil, dust bowl effect, shallow wells not protected, not consistent with Governor's wishes to protect farms, noxious weeds, tax losses, nitrogen on crops, livestock and ground water.

Response: See analysis in Chapter 3 regarding these issues.

Issue: Need another meeting to address Interagency agreements and input to consultants.

Response: EPA will require Northglenn and Weld County to execute an Intergovernmental agreement prior to grant award, See Chapter 5.

October 2, 1979 - EPA met with opponents of Plan in Loveland, Colorado. A list of requirements for the Intergovernmental agreement was presented and is discussed under the Management Agency Designation section in Chapter 5.

October 12, 1979 - EPA tours project area and meets with citizens near Frederick. Tailwater control, chlorination at Dacono and ground water contamination were discussed. A new issue raised was whether a proposed coal strip mine by Coors would create potential for ground water contamination. This issue will be addressed by the Office of Surface Mining, Department of Interior should Coors submit a mining plan.

TABLE 6-1

NORTHGLENN DISCUSSION PANEL

NAME	REPRESENTING
Weston Wilson	EPA, Panel Moderator
Dick Lundahl	City of Northglenn
Frank Culkins	Weisner Subdivision
Bill Schuler	Town of Frederick
Adolph Bolander	Farmers Reservoir and Irrigation Company
Elton Miller	Consolidated Ditch Company
Ray McNeil (Dick Johnson)	Denver Metro
John Hall	Weld County Health Department
John Kemp	Adams County
Bob Doyle	Denver Regional Council of Governments
John Rutstein	Larimer-Weld Council of Governments
Tess McNulty	Colorado League of Women Voters
Michael Richen (John Bermingham)	Colorado Open Space Council
Jerry Armstrong	Rocky Mountain Fuel Company

CHAPTER 7

LIST OF PREPARERS

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"Whatever an author puts between the two covers of his book is public property; whatever of himself he does not put there is his private property, as much as if he had never written a word."

Gail Hamilton
Country Living and Country Thinking (1862)

CHAPTER 7

LIST OF PREPARERS

Environmental Protection Agency

Weston W. Wilson - Project Officer - Environmental Engineer

B.S. in Geological Engineering and M.S. in Water Resources Administration from the University of Arizona, Tucson, Arizona. Five years experience with EPA as project officer for environmental impact statements for wastewater treatment facilities including Steamboat Springs, Colorado, and Jackson Hole, Wyoming. Special emphasis has been on land application of effluent, investigation of water rights, protection of environmentally sensitive areas and federal-state-local government agreements. Preparation of numerous EPA reports including water quality analyses, mined land reclamation reviews, power plant sitings and dredge and fill permits. Worked as EPA's consultant for the preparation of the President's National Water Policy.

William Rothenmeyer - Sanitary Engineer

B.S. in Civil Engineering at Rensselaer Polytechnic Institute in Troy, New York. Graduate level study at University of Colorado at Denver in Civil Engineering. Three and one half years experience with EPA in Regions II and VIII involved with permits and construction grants for municipal wastewater treatment facilities.

Engineering Science

Paul N. Seeley - Environmental Scientist

B.A. in environmental biology, University of Colorado. Six years experience in water quality monitoring, water resource planning environmental assessment, aquatic and terrestrial ecology, evaluation of land application, and impact analysis for a variety of wastewater treatment and disposal projects.

Allan L. Udin - Sanitary Engineer

B.S. and M.S. in Civil Engineering from Montana State University. Fourteen years experience in water and wastewater treatment facility planning, design, and operation. Projects have included water treatment and storage facilites, water transmission lines, water master plans, wastewater facilities plans, design of conventional and advanced wastewater treatment facilities, and plant operations consulting.

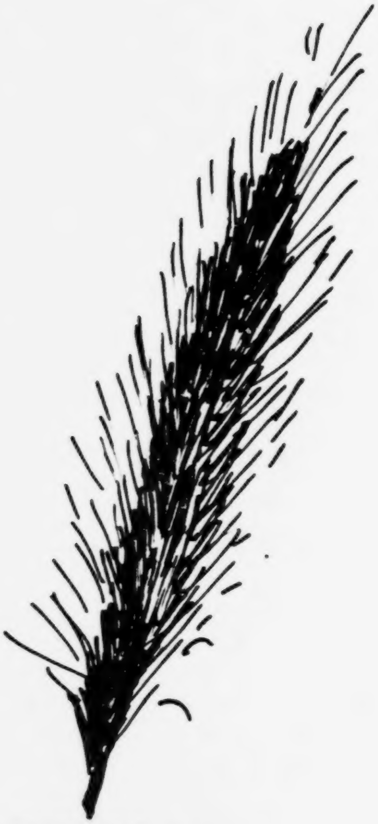
Bahman Sheikh-Ol-Eslami, Ph.D. - Agricultural Scientist

Ph.D. in Soil Science, University of California at Davis. Fourteen years experience in water management system planning, pollution control, and related environmental planning and design. Preparation of Environmental Impact Statements on wastewater projects, land application, and area-wide sewage plans. Analysis of the impacts to agriculture of irrigation with reclaimed wastewater.

Tipton and Kalmbach

Harold F. Bishop - Vice President

B.S. Civil Engineering University of Utah. Responsible for investigation and design of water resource projects, including detailed investigations of water rights, irrigation requirements, design of drainage facilities and hydraulic structures, feasibility reports and flood studies. He has served as Project Engineer on numerous water rights studies and has testified as an expert witness on water matters in various water courts in Colorado and in Jefferson County District Court. Over 50 percent of his work has been with water rights and consulting services to irrigation ditch companies.



APPENDIX

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APPENDIX A

DESCRIPTION OF THE EXISTING ENVIRONMENT

THE STUDY AREA

The proposed Northglenn plan affects a large geographical area north of the Denver metropolitan area. Included are the facilities for water supply, wastewater conveyance and treatment, urban stormwater collection, and augmentation elements of the various options. The key hydrologic features and political jurisdictions of concern in the Study Area are illustrated in Figure A-1.

Illustrated in Figure A-2 are the significant physical and land use features pertinent to this document (oversized - back of report).

COLORADO WATER RIGHTS AND ADMINISTRATION (1)

Colorado has a complex system of water administration and use. The system evolved from a mining and agriculturally based economy in which the demand for water often exceeded the supply. Because a major portion of the state's water is derived from melting snow high in the mountains, it is not distributed equally in either time or place.

In Colorado, the use of surface water, including underground water tributary to the surface system, is administered by the State under the Appropriation Doctrine. The State Constitution protects the right of water users to appropriate the waters of natural streams according to a "first in time, first in right" doctrine, limited only by the amount of water physically available to those able to put it to beneficial use without waste. Colorado was admitted to the Union in 1876, and at that time officially declared the Appropriation Doctrine to be the sole basis for the allocation of state waters.

Administration

The responsibility for water administration and control in Colorado is divided between the State Engineer, under the Division of Water Resources of the State Department of Natural Resources, and the Water Court. The State Engineer has jurisdiction to administer, distribute, and regulate the waters of the State. The Water Court has jurisdiction over matters which are specified by statute to be heard by the water judges in the state district courts within their respective divisions. Matters decided by the Water Court include determination of amounts and priorities on applications for new water rights, and findings of diligence in the perfection of conditional water rights. Also, the responsibility of the Water Court is the determination of rights with respect to proposed changes of water rights and plans for augmentation.

Diversions are regulated on the basis of priorities decreed by the Courts, generally in the order in which the water was first appropriated and put to beneficial use. A water right with an early appropriation date takes precedence over rights with later dates. Court

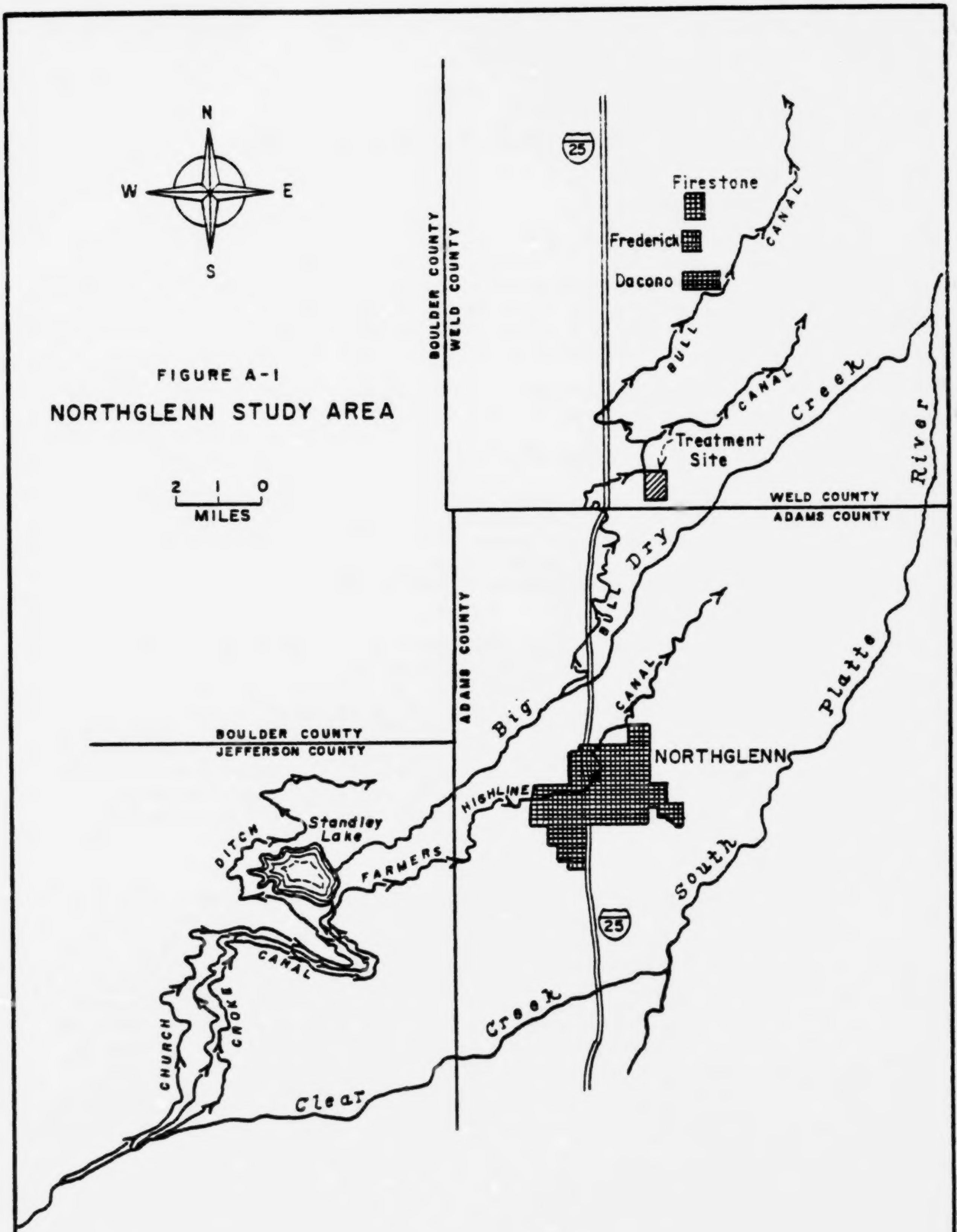

N
W
E
S
2 1 0
MILES
BOULDER COUNTY
WELD COUNTY
25
Firestone
Frederick
Dacono
BULL CANAL
CANAL
Treatment Site
Big Dry Creek
WELD COUNTY
ADAMS COUNTY
ADAMS COUNTY
BULL CANAL
South Platte River
BOULDER COUNTY
JEFFERSON COUNTY
NORTHGLENN
HIGHLINE
FARMERS
DITCH
Standley Lake
CANAL
CHURCH
CROKE
25
Clear Creek

FIGURE A-1

NORTHGLENN STUDY AREA

decrees also specify the permitted magnitude of diversion in terms of rate of flow for direct diversions and by volume for storage rights. A senior appropriator (i.e. one with an early date, whose right is not satisfied by the flow at his headgate) may call for water that is being diverted by a junior right upstream. This system of appropriation and administration thus determines the legal availability of water at a given location on a stream.

There are two categories of water rights which are defined by the time lag between diversion and use. Direct flow rights are for water diverted from the stream to a ditch and put to use more or less immediately. Storage rights are for water diverted from the flow of the stream and stored in a reservoir. This water is to be released for use at some later time, within the same year or in a subsequent year. Diversion for a storage right may be either for a reservoir off the stream channel from which it was diverted, or it may be for an on-channel reservoir.

The consumptive use of a crop is defined as the sum of two things; 1) transpiration, which is water entering crop roots and used to build tissue or is passed through the leaves of the crop into the atmosphere, or 2) evaporation, which is water evaporating from adjacent soil, water surfaces or from the surfaces of leaves of the crop (2). Because there is not enough rainfall to meet the water requirements of most crops in the Denver area, irrigation water from surface or groundwater supplies is needed to promote full crop growth and development.

Not all the water diverted is actually consumed in use, and the portion which returns to the stream and is available to downstream appropriators is known as return flow. The amount of consumptive use varies with the type of use and method of application. For irrigation, consumptive use ranges from 40 to 60 percent of diversions. Domestic and municipal consumptive use ranges from 5 to 40 percent while power generation and placer mining result in virtually no consumptive use.

Shallow ground water that is hydraulically connected to the surface system is defined as "tributary" water, and is also administered under the priority system. To protect the right of tributary wells to pump, it is necessary to adjudicate their priorities in the same manner as a surface appropriation.

Changes and Transfers

In Colorado, water rights are treated as real property and may be purchased or sold separately from the land to which they may be appurtenant. Water rights may be transferred from one location to another and the use to which the water is put in some cases may be changed. The principles governing such transfers and changes have been stated by the courts in Colorado, subject to certain conditions which relate primarily to protection of other appropriators from injury due to the change. Junior appropriators have vested rights in the continuation of stream conditions as they existed at the time of their respective appropriation. Mere ownership of a water right, however, does not mean that it is valuable and can be transferred or its use changed.

Augmentation Plans

The Water Right Determination and Administration Act of 1969 provides a means whereby complex water use projects and proposals can be reviewed by the court and a decree of approval granted. The technique is called a Plan for Augmentation and provides for legal recognition of total water supply systems. This proposal requires the application of the augmentation plan procedures in order to develop a reliable water supply for Northglenn's municipal use. In using water rights that have historically been used for irrigation to provide a municipal or industrial supply, special problems are sometimes encountered. These problems derive from the requirement that when a water right is changed there must be no injury to junior appropriators, and the fact that a municipal water supply is a year round use and must be highly dependable. To protect other appropriators on a stream, it is generally necessary to limit a change in use of a direct flow irrigation water right to the period of time that it was historically used beneficially. This means that it can provide water only during the irrigation season and not during the winter months. Water for winter use generally must be provided from reservoir storage by obtaining a new appropriation or by exchange. Storing a portion of the historic irrigation consumptive use during the time when it is legally available for later release to the stream to cover winter depletions is one method of exchange.

MEASUREMENT OF WATER

There are two types of units commonly used in this report to define water measurement. These are units of volume and units of discharge. The unit of volume commonly employed in irrigation practice is the acre-foot. An acre-foot is defined as the quantity of water required to cover one acre of land to a depth of one foot, or 43,560 cubic feet (3). There are 325,900 gallons in one acre-foot.

Discharge, or the rate of flow, is defined as the volume of water that passes a particular reference section in a unit of time. The units of discharge commonly used are gallons per minute (gpm) and cubic feet per second (cfs). One cfs is equivalent to 449 gpm.

The miners inch, or inch, was originally used in hydraulic mining and irrigation in the Western United States and is still commonly used in many areas. The use of this unit leads to confusion because the definition varies between states. In Colorado, one inch is the quantity of water which will flow through an orifice one inch square under a head of 5 inches. One Colorado inch is equal to about 12 gpm and 38.4 inches equals one cubic foot per second. Many ditch companies use the term "inch" to define the proportionate share of water in the ditch to which users are entitled. In this case the value of an inch varies with the amount of water actually in the ditch.

WATER RESOURCES IN THE STUDY AREA

Historically, the major use of water in the South Platte River Basin was by agriculture. While this is still the case, urbanization of the metro-Denver area and other areas throughout the region have taken lands out of crop production/agricultural use. As urbanization continues, additional lands will be taken out of production due to development pressures and the economic difficulties facing farmers in an urbanizing environment.

The South Platte River and its tributaries in the Denver area are fully appropriated. Water is available to junior appropriators only during periods of flood runoff. A new direct flow water right would not be a dependable or reliable source. Because the Denver metropolitan area continues to grow and water needs increase, it is necessary to look to various means to meet these new demands.

Storage is one method of increasing water availability through more efficient use of existing water supplies. Any new storage appropriation in the South Platte Basin will be junior to the proposed Narrows Project on the South Platte River in eastern Colorado, and the amount and frequency of water availability to the new facility would have to be carefully analyzed. In addition, there are many public and environmental concerns relating to storage which currently make other alternatives more desirable in terms of economic feasibility.

Transbasin water is another source of new water. This is an expensive means of water development, both in terms of facility construction and potential environmental impact on the basin of origin. Any new transbasin water project can be expected to take many years to develop.

A third water source is nontributary groundwater. Under current state administration policy, the amount of such water available for use depends upon the amount of land owned or controlled by the applicant. This concept is now being tested in court with the argument that nontributary ground water should be subject to the Appropriation Doctrine. Complete dependence on a nontributary ground water supply for a municipality is questionable, given the potential for limited useful life of the ground water aquifer.

The final source of water for municipal development is through acquisition of existing water rights and changing them to the new use. At the present time this is generally the easiest and most economical way to develop a water supply. Since agriculture uses about 95 percent of the water available in Colorado, it is a prime source for water acquisition. When agricultural water is acquired for a municipal system, the lands historically served are usually taken permanently out of production.

WATER SUPPLY SOURCES FOR NORTHGLENN

While the Northglenn plan incorporates some water from all of the sources mentioned previously, the biggest potential impact is on agriculture in the South Platte River Basin as it provides the most convenient and economical source of water for a municipal development. The significant feature of Northglenn's plan, however, is that a portion of the water used will be borrowed from agriculture, treated, and returned for agricultural use, thus mitigating at least some of the adverse impact to agriculture.

Northglenn's Water Sources

Northglenn's proposed raw water supply is based upon the yield from ownership or share ownership of water rights in the following:

a. The Standley Lake division of FRICO through direct ownership of shares;

b. The Standley Lake division of FRICO through the exchange proposal;

c. The Berthoud Pass Ditch, a transmountain ditch historically used as an irrigation supplement by FRICO;

d. Nontributary ground water beneath the City of Northglenn;

e. The Farmers Highline Canal historically used for agricultural irrigation in the area north of Clear Creek through share ownership in the Farmers Highline Canal and Reservoir Company; and

f. The Church Ditch also historically used for agricultural irrigation north of Clear Creek through share ownership in the Golden City and Ralston Creek Ditch Company.

A key feature of Northglenn's plan is the agreement with FRICO allowing Northglenn to borrow from Standley Lake the difference between their municipal water requirement and the amount of water Northglenn can provide under their own ownership. Any water so borrowed is returned with a 10 percent bonus to the Bull Canal users under the Standley Lake system for agricultural use. Northglenn has expressed their intention to continue irrigating those lands in FRICO they have purchased for water acquisition purposes subject to the availability of water. In a dry year, for example, all water would be needed by the City and there would be no excess water.

A description of the various raw water sources follows:

Standley Lake: The Standley Lake division is one of four main divisions of FRICO. The system serves a total area of slightly more than 15,000 acres and there are currently 2,373 outstanding shares of stock (2). As of August 1979 the cities of Westminster, Thornton and Northglenn owned or controlled 923 shares or 39 percent of the stock (4). The total capacity of Standley Lake is 42,000 acre-feet; however, FRICO has the use of only 20,000 acre-feet and, after the cities' share ownership is claimed as stipulated in the four-way agreement, there are only 12,220 acre-feet available for other shareholders. Due to the water acquisition policy of these cities, the shares owned by the cities are constantly increasing. The water rights associated with Standley Lake are listed below (5):

a. The Standley Reservoir in former Water District No. 2, for 940.36 acre-feet of water for irrigation purposes from Woman Creek with an appropriation date of September 1, 1869, decreed on August 2, 1918.

b. The Kinnear Ditch in former Water District No. 2, for 40.47 cubic feet of water per second for irrigation purposes from Woman Creek with an appropriation date of September 1, 1869, decreed on August 2, 1918.

c. The Kinnear Reservoir 1st Enlargement in former Water District No. 6, for 49,488 acre-feet of water for irrigation purposes from Coal Creek with an appropriation date of March 4, 1902, decreed on June 21, 1926.

d. The Croke Canal in former Water District No. 7, for 1056.00 cubic feet of water per second (conditional) for irrigation and domestic purposes from Clear Creek with an appropriation date of March 4, 1902, decreed on May 13, 1936.

e. The Croke Canal in former Water District No. 7, for 944.00 cubic feet of water per second for irrigation and domestic purposes from Clear Creek with an appropriation date of March 4, 1902, decreed on May 13, 1936.

f. The Standley Lake Reservoir in former Water District No. 7, for 32,361 acre-feet of water for irrigation and domestic purposes from Clear Creek with an appropriation date of March 4, 1902, decreed on May 13, 1936.

g. The Standley Lake Reservoir in former Water District No. 7, for 16,699 acre-feet of water (conditional) for irrigation and domestic purposes from Clear Creek with an appropriation date of March 4, 1902, decreed on May 13, 1936.

h. The Standley Reservoir Ditch in former Water District No. 6, for 26.47 cubic feet of water per second for irrigation purposes from Coal Creek with an appropriation date of May 20, 1872, decreed on June 2, 1882.

i. The Standley Reservoir in former Water District No. 6, for 940.00 acre-feet of water for irrigation purposes from Coal Creek with an appropriation date of September 1, 1869, decreed on December 19, 1900.

j. The Standley Lake Enlargement in former Water District No. 6, for 18,000 acre-feet of water (conditional-abandoned) for irrigation purposes from Coal Creek with an appropriation date of December 31, 1929, decreed on September 28, 1953.

k. The Berthoud Canal Tunnel in former Water District No. 51 (Division 5), for 53.40 cubic feet of water per second for irrigation purposes from the Fraser River with an appropriation date of June 30, 1902, decreed on August 3, 1911. The ditch generally operates between May and September.

Church Ditch: The Church Ditch (Golden Ralston Creek and Church Ditch Company) is a carrier ditch company whose physical facilities and water rights are primarily owned by FRICO (6). There are a total of 5,710.64 inches in the ditch of which Northglenn owns the right to purchase 415.205 inches of water. The source of supply is Clear Creek and the water rights are detailed in a copy of the Change of Water Rights Application in Appendix D. FRICO owns 29 percent of the total inches in the ditch and has in the past diverted water to Standley Lake when not required for operational purposes (6).

Farmers Highline Canal: The Farmers Highline Canal diverts from the north bank of Clear Creek. In addition, the ditch has rights in Big Dry Creek, Ralston Creek and Leyden Creek. The water rights are listed in a copy of a Change of Water Rights Application in Appendix D. Northglenn owns 7.7125 shares out of 1094 shares in the ditch. Northglenn can take the water into Standley Lake or can take it directly to the city for park irrigation.

Nontributary Ground Water: Northglenn has filed applications to construct deep wells for a total of 2300 acre-feet of nontributary ground water from the Laramie-Fox Hills and Arapahoe aquifers underlying the City. With the exception of Arapahoe Well No. 7, the State Engineer denied the permits. Under current water administration policy, the amount of water available from nontributary sources is based on surface land ownership, and Northglenn currently claims ownership or control of sufficient land to yield 650 acre-feet of water per year. It is Northglenn's position that it is not practical or economically feasible for any individual or group of individuals within the City to develop his own deep well supply and the full 2300 acre-feet per year underlying the City should be available to the City for development. The matter is currently pending with the Water Court.

REPLACEMENT WATER

Under terms of the agreement with FRICO, Northglenn must return the total amount of water borrowed for use of the City plus a 10 percent bonus. In addition, evaporation from the reservoir constructed to hold the water until released to the Bull Canal system must be included in the total replacement water requirement. The primary replacement water source will be treated wastewater from Northglenn. Included in the Northglenn replacement program is wastewater from an enclave of Thornton and all sewer line infiltration from the collection system.

A second source of replacement water is urban storm runoff in Grange Hall Creek which will be captured and diverted for treatment at the sewage plant. Northglenn has junior (1971) water rights for storm runoff from the city (7). The diversion will occur at a planned 30 acre-foot detention pond on Grange Hall Creek near the eastern edge of the City.

The third source of replacement water which may be required under certain dry year conditions is a planned well field located near the South Platte River, which will pump tributary water from the South Platte to a pumping station located near the Grange Hall Creek detention pond and to the Bull Canal Reservoir site. Northglenn plans a total of five wells to provide supplementary water for replacement purposes, but a specific site for the tributary well field has not yet been specified.

WATER QUALITY

Water Quality Criteria

The proposed Colorado stream water quality criteria (8) were used to assess the existing water quality. Criteria for water supply, recreation, and agriculture were used. The pertinent criteria for these uses are presented in Table A-1.

Surface waters suitable for a water supply are defined as follows:

> "Waters which after receiving approved disinfection such as simple chlorination or its equivalent or which after receiving standard treatment (defined as coagulation, flocculation, sedimentation, filtration and disinfection or its equivalent) will meet Colorado drinking water regulations and any revisions amendments, or supplements thereto." (8)

Recreational water is separated into Class I and Class II by the State of Colorado. These are defined as follows:

> Class I - "These surface waters are suitable or intended to become suitable for prolonged and intimate contact with the body or for recreational activities when the ingestion of small quantities of water is likely to occur. Such waters include but are not limited to those used for swimming." (8)
>
> Class II - "These surface waters are suitable for recreational uses on or about the water which are not included in the Class I category."

Agricultural waters are defined as:

> "These waters are suitable or intended to become suitable for irrigation of crops usually grown in Colorado and which are not hazardous as drinking water for livestock."

TABLE A-1

WATER QUALITY PARAMETERS AND CRITERIA

		Use			
Category	Parameter	Water Supply	Recreation		Agriculture
			Class I	Class II	
Physical	Temperature, °C	-	-	-	-
	pH, units	5.0 - 9.0	6.5 - 9.0	-	-
	Dissolved Oxygen, mg/l	aerobic	aerobic	aerobic	aerobic
	Alkalinity, mg/l-$CaCO_3$	-	-	-	-
	Color	free from	free from	free from	free from
	Turbidity, TU	-	-	-	-
	TDS, mg/l	-	-	-	-
	TSS, mg/l	-	-	-	-
	TVS, mg/l	-	-	-	-
	Settleable solids, mg/l	-	-	-	-
	Hardness	-	-	-	-
	Conductivity, mmhos	-	-	-	-
Nutrients/ Organics	Phosphate, mg/l	-	-	-	-
	Phosphorus	-	-	-	-
	Ortho-phosphate, mg/l	-	-	-	-
	Nitrate-N, mg/l	10	-	-	100
	Nitrite-N, mg/l	1.0	-	-	10
	COD, mg/l	-	-	-	-
	BOD, mg/l	-	-	-	-
	Organic Nitrogen, mg/l	-	-	-	-
	TKN	-	-	-	-
Biological	Total Coliform, #/100 ml	-	-	-	-
	Fecal Coliform, #/100 ml	2000	200	2000	-
Toxics	Ammonia-N, mg/l	0.5	-	-	-
	Fluoride, mg/l*				
	Cyanide, mg/l	0.2	-	-	0.2
Metals	Aluminum, mg/l	-	-	-	-
	Arsenic, mg/l	0.05	-	-	0.1
	Cadmium, mg/l	0.01	-	-	0.01
	Chromium, mg/l	0.05	-	-	0.1
	Copper, mg/l	1.0	-	-	0.2
	Iron, mg/l (dissolved)	0.3	-	-	-
	Lead, mg/l	0.05	-	-	0.1
	Magnesium, mg/l	-	-	-	-
	Manganese, mg/l (dissolved)	0.05	-	-	0.2
	Molybdenum, mg/l	-	-	-	-
	Selenium, mg/l	0.01	-	-	0.02
	Zinc, mg/l	5.0	-	-	2.0
Inorganic Minerals	Chloride, mg/l	250	-	-	-
	Sodium, mg/l				
	Sulfate, mg/l	250	-	-	-
	Calcium, mg/l	-	-	-	-
	Boron, mg/l	-	-	-	0.75

*Fluoride levels vary based on annual average of the maximum daily air temperature.

Existing Water Quality

Water quality and quantity underlie the major issues of the Northglenn plan. The quality of water can effect both agricultural productivity and public health. Within the Northglenn-FRICO area quality data exist on several bodies of water. To facilitate the evaluation of these data the various waters have been segregated into two hydrologic systems. The Clear Creek system includes Clear Creek, the Church Canal, the Croke Canal, the Farmers Highline Canal, Allen Ditch, and Standley Lake. The Big Dry Creek system includes Big Dry Creek and the Bull Canal (see Figure A-3).

In order to effectively present the existing water quality data of the two systems stream profiles are used. A profile is a graphic representation of a system with river miles as the horizontal axis and parameter concentration as the vertical axis. The principal rivers and canals are illustrated on each profile map. The profile maps are used to display mean and maximum/minimum values of each parameter at each station. The number of events comprising each sample set is also presented. Water quality profiles for nitrate and fecal coliform concentrations for the Clear Creek and Big Dry Creek systems are presented in Figures A-4 through A-7.

The utility of water quality data is dependent, in part, upon the number and frequency of samples that are collected. The data on Clear Creek are the most comprehensive, while the Bull Canal data are of questionable value since only one sample set is available for analysis.

The existing water quality data base is a compilation of in-situ parameter concentrations for 40 constituents measured at 22 stations. The existing water quality data base is summarized in Table A-2.

Physical Parameters

Water quality criteria are proposed for three of the twelve physical parameters/constituents that have been monitored. Of the three only pH has numeric criteria, 5.0-9.0 and 6.5-9.0 for water supply and Class I, recreation, respectively. The mean pH values reported in the Clear Creek system and the Big Dry Creek system range from 7.7 to 8.3, well within the criterion range.

Concentrations of color, turbidity, suspended solids, volatile solids, settleable solids, hardness, and conductivity in Clear Creek and Big Dry Creek appear to be influenced by wastewater discharges into these waters and possibly by seasonal variations.

Nutrients/Organics

A total of nine parameters in this category have been monitored. The water supply and agricultural criteria for nitrate are 10 mg/l and 100 mg/l, respectively. The nitrite criteria for water supply and

TABLE A-2

SUMMARY OF EXISTING WATER QUALITY

Parameter	CRITERIA				RANGE OF MEAN VALUES REPORTED							
	WS	Rec I	Rec II	Ag	Clear Cr.	Croke Cnl	Church Dtch	Farmers Hghln	Allen Dtch	Standley Lake	Big Dry Cr	Bull Canal
Temperature, °C	-	-	-	-	8.1-12.9	10.6-14.9	8.1	10.9	18.4	10.8-14.3	7.4-9.9	N.D.[1]
pH, Units	5-9	6.5-9.0	-	-	7.8-8.2	7.8	7.9	8.0	8.0	7.9-8.3	7.8-8.1	7.8-8.0
DO, mg/l	---------aerobic-------				10.7-10.9	7.2	7.9	7.4	6.7	5.3-6.3	7.5-8.0	N.D.[1]
Alkalinity, mg/l	-	-	-	-	36.0-174.5	68.6-114.7	47.6	51.2	51.5	79.1-84.3	177.0-218.9	N.D.
Color, units	-	-	-	-	N.D.	30.5-52.2	37.1	43.4	35	6.3-38.2	17.0-64.0	N.D.
Turbidity, TU	-	-	-	-	12.0-31.4	11.6-20.1	8.7	25.3	28.9	3.9-44.4	7.0-41.1	3.0-62.0
TDS, mg/l	-	-	-	-	22.2-47.2	263-368	163	187	169	203-327	300-843	290-340
TSS, mg/l	-	-	-	-	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	39-800	64-520
TVS, mg/l	-	-	-	-	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	11-23	N.D.
Set Solids, mg/l	-	-	-	-	0.12-1.0	N.D.	N.D.	N.D.	N.D.	N.D.	0.1-0.26	N.D.
Hardness	-	-	-	-	96-199	128-134	83.5	89.4	74.8	111-119	253-365	N.D.
Conductivity, mmhos	-	-	-	-	0.2-0.7	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Phosphate, mg/l	-	-	-	-	0.14-2.96	0.52-1.32	0.22	0.49	0.03	0.08-0.12	0.18-3.64	N.D.
Phosphorus, mg/l	-	-	-	-	0.09-1.02	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Ortho-Phosphate, mg/l	-	-	-	-	N.D.	0.29-1.00	0.01	N.D.	0.08	0.08	0.05-3.34	N.D.
Nitrate, mg/l	10	-	-	100	0.47-1.78	0.27-0.41	0.24	0.32	0.2	0.04	0.07-3.35	0.4-0.9
Nitrite, mg/l	1.0	-	-	10	0.007-0.14	0.006-0.01	0.01	0.002	0.0	0.005-0.01	0.02-0.56	0.1
COD, mg/l	-	-	-	-	40.0	22.0-76.9	16.8	26.9	14.0	17.4-27.0	35.5-55.1	N.D.
BOD, mg/l	-	-	-	-	2.2-7.8	N.D.	N.D.	N.D.	N.D.	N.D.	2.5-10.1	1.9-4.5
TKN, mg/l	-	-	-	-	3.5-5.8	N.D.	N.D.	N.D.	N.D.	N.D.	1.7	1.7-4.8
Total Coliform, #/100 ml	-	-	-	-	1149-63,000	591-13,000	91	412	1710	14-28	441-8644	N.D.
Fecal Coliform, #/100 ml	2000	200	2000	-	424-21,000	N.D.	N.D.	N.D.	N.D.	N.D.	30-133	10-110
Ammonia, mg/l	0.5	-	-	-	0.22-2.46	0.21-0.35	0.28	0.17	0.09	0.11-0.22	0.19-5.41	0.1
Fluoride, mg/l[2]					0.69-0.79	0.87-0.97	0.69	0.90	0.54	0.69-0.76	0.7-1.39	0.77-0.9
Cyanide, mg/l	0.2	-	-	0.2	0.0-0.0009	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Aluminum, mg/l	-	-	-	-	0.0-0.0024	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Arsenic, mg/l	0.05	-	-	0.1	0.0-0.0007	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Cadmium, mg/l	0.01	-	-	0.01	0.0001-0.0005	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Chromium, mg/l	0.05	-	-	0.1	0.0-0.0038	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Copper, mg/l	1.0	-	-	0.2	0.009-0.046	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Iron, mg/l (diss)	0.3	-	-	-	0.71-0.91	0.87-1.2	1.3	1.8	2.6	0.18-2.08	0.05-1.68	0.05-0.11
Lead, mg/l	0.05	-	-	0.1	0.007-0.019	N.D.	N.D.	N.D.	N.D.	N.D.	0.03-0.02	0.01-0.02
Magnesium, mg/l	-	-	-	-	8.5-12.4	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Mangenese, mg/l dissolved	0.05	-	-	0.2	0.31-0.68	0.55-0.65	0.9	1.2	0.6	0.12-0.55	0.05-7.0	0.1-0.31
Molybdenum, mg/l	-	-	-	-	0.032-0.13	0.20	0.4	0.39	0.02	N.D.	N.D.	N.D.
Selenium, mg/l	0.01	-	-	0.02	0.0001-0.0013	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Zinc, mg/l	5.0	-	-	2.0	0.08-0.55	N.D.	N.D.	N.D.	N.D.	N.D.	0.04-0.09	0.04-0.09
Chloride, mg/l	250	-	-	-	10.0-49.9	8.8-29.6	3.8	3.7	5.4	8.9-10.2	11-47.5	9.0-13.0
Sodium, mg/l	-	-	-	-	15.2-74.4	N.D.	N.D.	N.D.	N.D.	N.D.	33-240	36-44
Sulfate	250	-	-	-	68.0-143.0	N.D.	76.0	N.D.	N. D	N.D.	75-435.2	75-100
Calcium, mg/l	-	-	-	-	67.6-147.9	32.8-42.7	21.5	23.1	21.4	37.2-38.6	N.D.	N.D.
Boron, mg/l	-	-	-	0.75	0.03-0.17	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

[1] N.D. - No Data

[2] Criteria based on annual average of the maximum daily air temperature.

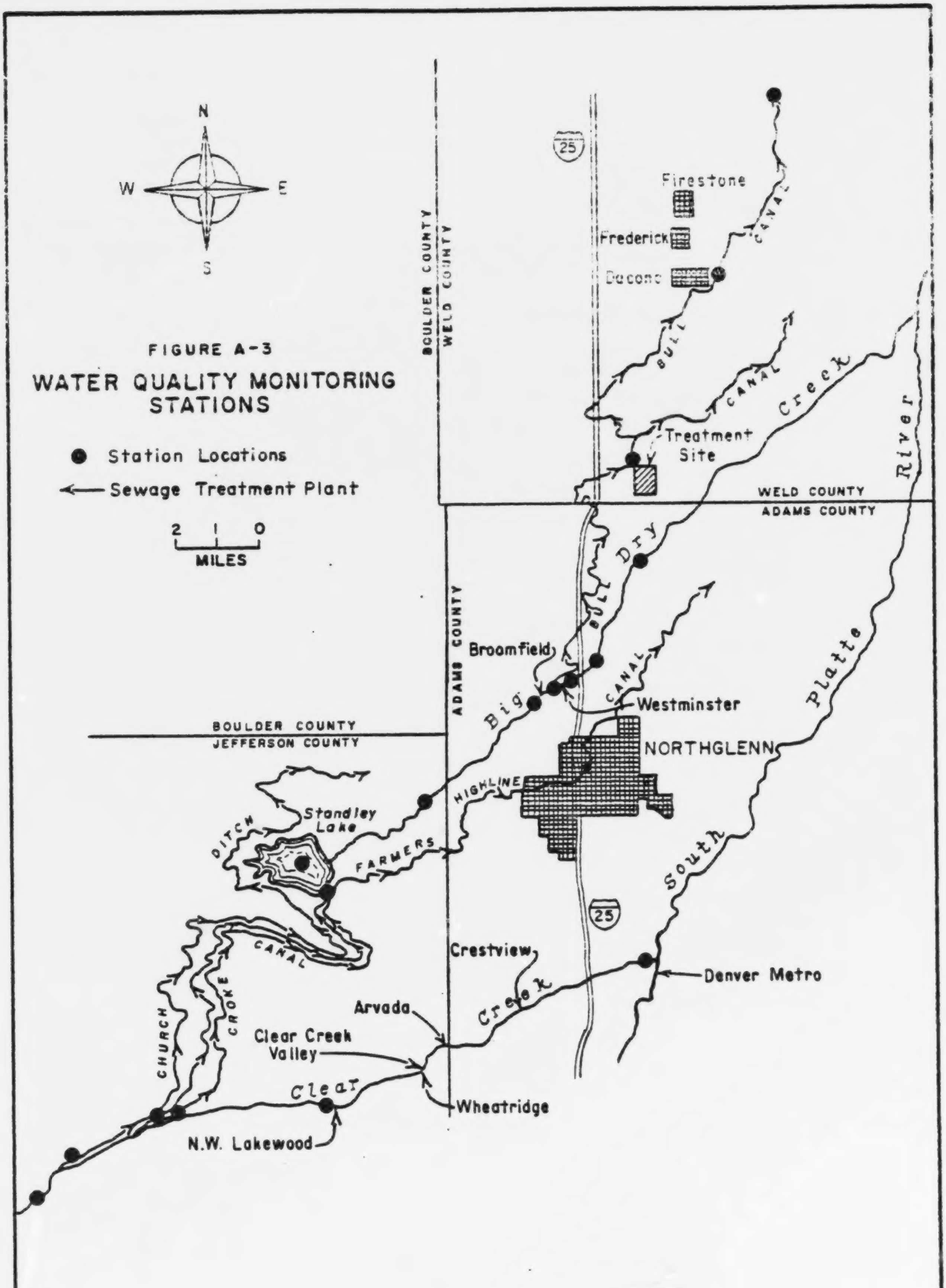


FIGURE A-3

WATER QUALITY MONITORING STATIONS

N
W
E
S
● Station Locations
← Sewage Treatment Plant
2 1 0
MILES
BOULDER COUNTY
WELD COUNTY
25
Firestone
Frederick
Dacono
CANAL
BULL
CANAL
Creek
Treatment Site
River
WELD COUNTY
ADAMS COUNTY
Dry
BULL
ADAMS COUNTY
Broomfield
CANAL
Big
Westminster
Platte
BOULDER COUNTY
JEFFERSON COUNTY
NORTHGLENN
HIGHLINE
Standley Lake
DITCH
FARMERS
South
25
CANAL
Crestview
Denver Metro
CHURCH
CROKE
Creek
Arvada
Clear Creek Valley
Clear
Wheatridge
N.W. Lakewood

agriculture are 1.0 mg/l and 10 mg/l, respectively. The agriculture and water supply nitrate criteria have not been violated in either the Clear Creek system or the Big Dry Creek system. Nitrate and nitrite mean concentrations increase below wastewater treatment plants but do not exceed criteria.

The remaining parameters exhibit similar trends of increasing concentrations below treatment plants.

Biological Parameters

Coliform bacteria are organisms that indicate the possible presence of disease causing organisms such as pathogenic bacteria, virus, worms, and protozoas. The use of total coliform as an indicator of pathogenic organisms has a long history. However, there is variable correlation of total coliform content with contamination by excreta. Fecal coliform is a more specific indicator of warm-blooded animal contamination. This is substantiated through examination of the excrement from other warm-blooded animals which indicates that fecal coliformscontribute to 93 percent of the total coliform populations. Fecal coliform criteria for a raw water supply and for Class I and Class II recreation are 2000/100 ml, 200/100 ml, and 2000/100 ml, respectively.

Total coliform concentrations in Clear Creek increase downstream. Mean total coliform concentrations range from 1149/100 ml, above Golden, to 62,939/100 ml near its mouth. Increases in the lower stream segment are believed to be, in part, a result of wastewater discharges. Canals taking water out of Clear Creek have mean total coliform densities at their headgates that range from 91/100 ml to 12,992/100 ml. Standley Lake has mean concentrations below 30/100 ml throughout its profile.

Mean concentrations of total coliform in Big Dry Creek range from 441/100 ml to 8644/100 ml. The Broomfield wastewater treatment plant discharge appears to increase concentrations.

Mean concentrations of fecal coliform in Clear Creek increase significantly as the stream passes through Denver. Mean concentrations increase from above Golden (424/100 ml) to the mouth (21,000/100 ml). These values exceed all criteria. No fecal coliform data are currently available for the canals or Standley Lake. (See Figure A-6.)

Mean fecal coliform concentrations in Big Dry Creek above and below the Broomfield treatment plant are about 50/100 ml. Concentrations below the Westminster treatment plant indicate concentrations decrease downstream. Mean concentrations in the Big Dry Creek and Bull Canal are below the Class I recreation criterion of 200/100 ml. (See Figure A-7.)

Toxic Parameters

The water supply criterion for ammonia is 0.5 mg/l. Violations of this value are noted in the lower segments of Clear Creek. This is partly the result of wastewater treatment plant discharges. Ammonia concentrations in Big Dry Creek below the Broomfield treatment plant violate the criterion but values in the Bull Canal do not.

The water supply and agricultural criterion for cyanide is 0.2 mg/l. This value is exceeded near the mouth of Clear Creek. No other toxic contaminants are present in toxic concentrations in the system.

Metals

Data for arsenic, cadmium, chromium, copper, and selenium are currently only available in Clear Creek. Data for zinc and lead are available for both the Clear Creek and Big Dry Creek systems. Mean concentrations of all of these parameters are below their respective criterion.

Water supply criterion (0.05 mg/l) for manganese are for dissolved, while the agriculture criterion (0.2 mg/l) is for total. Data are for concentrations of total manganese. The agriculture criterion is violated at all monitoring stations in the Clear Creek system. Only one station in the Bull Canal exceeded the agriculture criteria.

Inorganic Minerals

Inorganic minerals for which data are currently available include: chloride, sodium, sulfate, calcium, and boron. Water supply criteria have been recommended for chloride (250 mg/l) and sulfate (250 mg/l) while agriculture criterion are recommended only for boron (0.75 mg/l).

Chloride concentrations in both the Clear Creek system and the Big Dry Creek system are well below criterion limits.

Sulfate criterion is exceeded in Big Dry Creek at five stations. Mean concentrations at these stations range from 273 mg/l to 435 mg/l.

Boron data are currently only available in Clear Creek. Mean concentrations are below the agriculture criterion of 0.75 mg/l.

Radionuclides

Radionuclides have been monitored in Standley Lake sediment to determine if contamination by emissions from Rocky Flats Plutonium Plant has occurred (19). The primary parameter of concern to the study was plutonium 239.

The Colorado water quality standards (8) state that, "the radioactivity of surface waters shall be maintained at the lowest practicable level and shall, in no case, except when due to natural causes, exceed the latest federal drinking water standard."

Taken collectively, the plutonium-239 results for sediment samples collected from Standley Lake did not indicate any discernible contamination.

Standley Lake is within the"Area of Concern" as defined by the Colorado Department of Health. Areas of concern are downwind of the Rocky Flats Plant where exposure risks would be the greatest during a radiation emergency. EPA requires the development of a notification mechanism for existing and prospective residences who would be effected by an emergency condition at Rocky Flats, based on the State Radiological Emergency Response Plan including the grantees role in carrying out prescribed protective actions. (See Chapter 5).

Conclusion

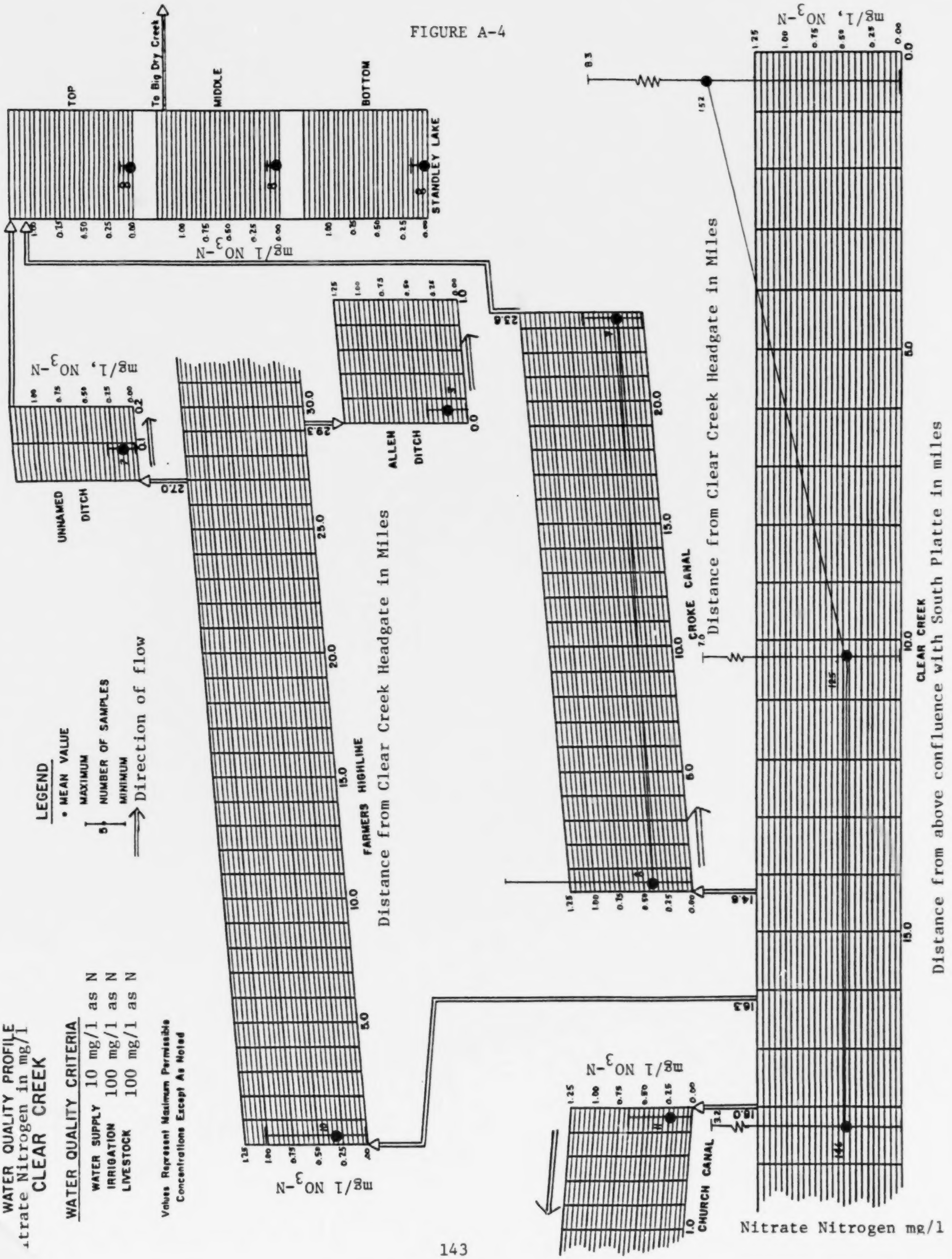
The existing water quality data for the Clear Creek and Big Dry Creek systems has been evaluated in terms of compliance with water quality criteria for water supply, recreation and agriculture. The quality of water in irrigation canals seems to remain relatively constant throughout their reaches. Conversely, maintenance streams such as Clear Creek and Big Dry Creek have fluctuating water quality. This situation is a result, in part, of wastewater treatment facilities discharging into the main streams, while irrigation canals receive limited pollutant contributions from urban areas.

Data on the Bull Canal are limited to one sample. Supplemental monitoring has occurred but these data were not available at the time of this report. From the limited data, water quality in the Bull Canal is of a relatively good quality.

Manganese and BOD are parameters of interest in this analysis because the concentrations in the Bull Canal appear to be related to the Broomfield wastewater treatment plant. The differences in concentration in the Bull Canal and Big Dry Creek are probably a result of different monitoring periods. It is thought that additional monitoring of the two streams would correlate water quality in the headwaters of the Bull Canal more closely to the Big Dry Creek water quality and influence from Broomfield.

Two parameters are of special concern to this assessment, fecal coliform and nitrates. Fecal coliform is an indicator of possible health risks. Nitrates can create problems for water supplies and nitrogen sensitive crops. Existing water quality data in the Bull Canal indicates these parameters are below their criterion limits. However, fecal coliform concentrations in Big Dry Creek and in Clear Creek increase below wastewater treatment plants. Similarly, nitrate, nitrite, and ammonia-nitrogen concentrations increase below wastewater discharges.

FIGURE A-4



WATER QUALITY PROFILE
Nitrate Nitrogen in mg/l
CLEAR CREEK

WATER QUALITY CRITERIA

WATER SUPPLY	10 mg/l	as N
IRRIGATION	100 mg/l	as N
LIVESTOCK	100 mg/l	as N

Values Represent Maximum Permissible Concentrations Except As Noted

LEGEND
- • MEAN VALUE
- MAXIMUM
- 5 NUMBER OF SAMPLES
- MINIMUM
- ⟹ Direction of flow

FIGURE A-5

WATER QUALITY PROFILE

BIG DRY CREEK

Nitrate Nitrogen in mg/1

WATER QUALITY CRITERIA

WATER SUPPLY	10 mg/1 as N
IRRIGATION	100 mg/1 as N
LIVESTOCK	100 mg/1 as N

Values Represent Maximum Permissible Concentrations Except As Noted

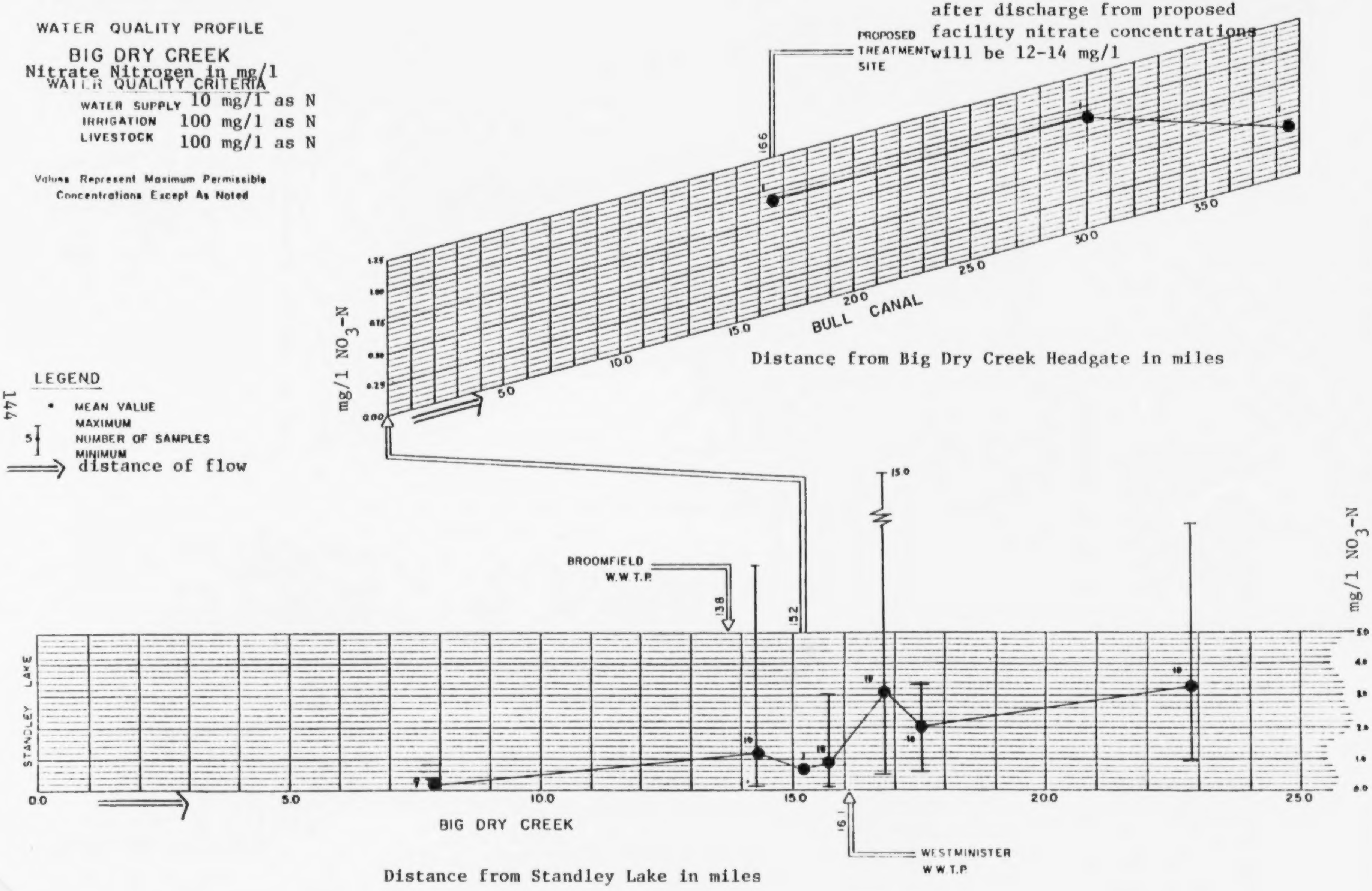
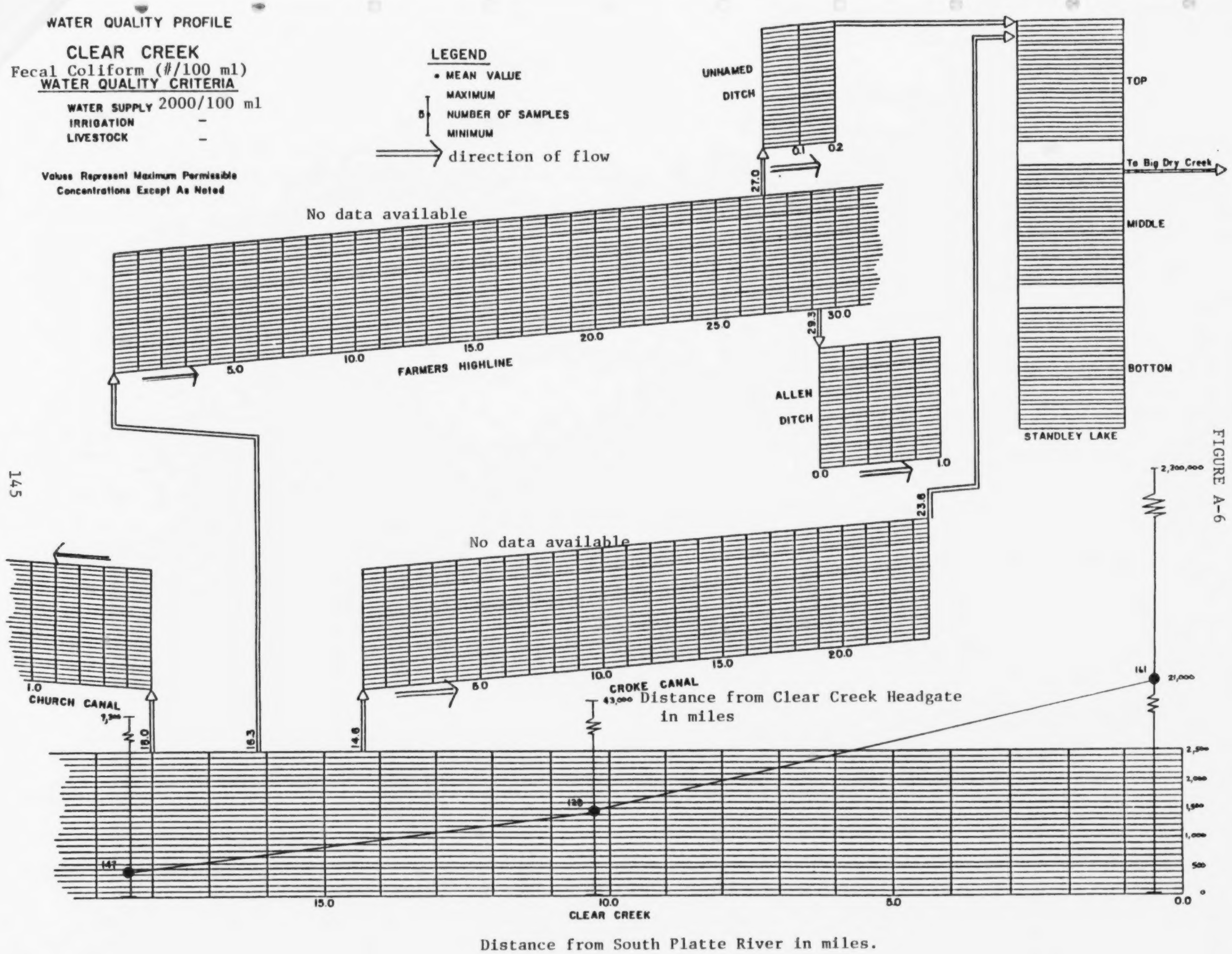


FIGURE A-6



Distance from South Platte River in miles.

FIGURE A-7

WATER QUALITY PROFILE

BIG DRY CREEK
Fecal Coliform (#/100 ml)
WATER QUALITY CRITERIA

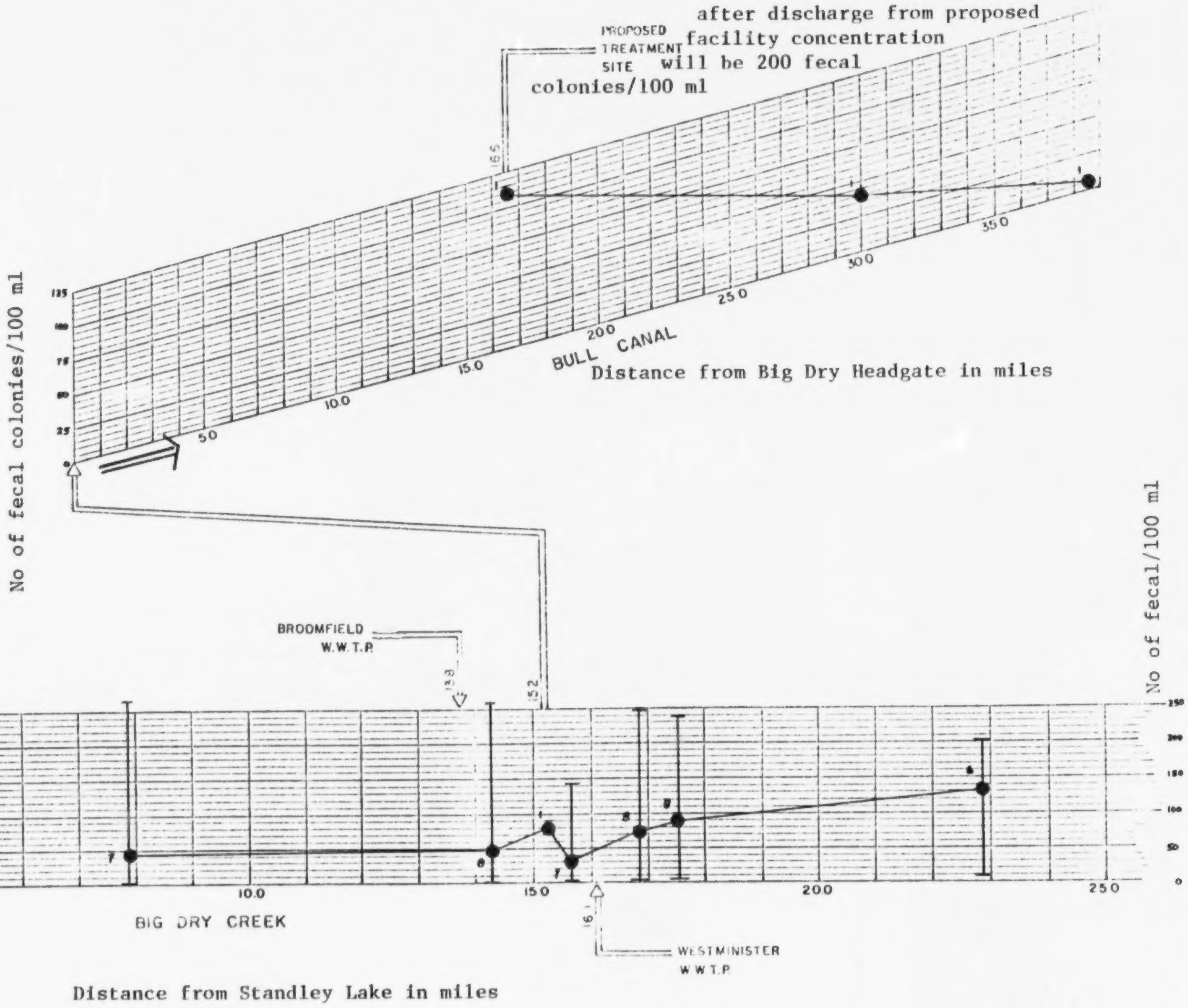
WATER SUPPLY	2000/100 ml
IRRIGATION	-
LIVESTOCK	-

Values Represent Maximum Permissible Concentrations Except As Noted

LEGEND

- • MEAN VALUE
- ⊤ MAXIMUM
- 5 NUMBER OF SAMPLES
- ⊥ MINIMUM

⟹ Direction of flow



AGRICULTURE IN THE STUDY AREA

Agriculture is an extremely important industry in the State of Colorado, along the front range, and in the FRICO and lower South Platte portions of the Study Area. Through urban encroachment, land erosion, land policies, or land development, Colorado has lost six percent of its productive land in the last two decades (9). Along the Front Range irrigated crop land has decreased from 700,000 acres to 660,000 acres from 1959 to 1978 (9). In view of the potentially critical impact nationwide of the reduction in agricultural land, the current EPA policy is ". . . to protect. . . . the Nation's environmentally significant agricultural land from irreversible conversion to uses which result in its loss as an environmental or essential food production resource." (10)

To understand the implications of the proposed exchange of reclaimed water for irrigation water, it is necessary to first define the soils, irrigation practices, crops, and current productivity of the agricultural lands in the Study Area.

Soils and Soil Productivity

The USDA Soil Conservation Service (SCS) has conducted detailed soil surveys for the region. The soils survey for Southern Weld County is, at present, unpublished (11, 12). The major soils within the Study Area have a textural range from sandy loams to clay loams, with minor areas identified as clays and sands. Soils of the region generally reflect the tertiary and pleistocene sediments at the eastern edge of the Rocky Mountain system, with minor sediments derived from the Denver and Arapahoe Arkose formation. Recent alluvium deposits occur along major stream valleys. Soils can generally be grouped into the high terrace and alluvial fan soils, old terrace and plains soils, ridgecrest and slope soils, upland soils, floodplain soils, and the sandhill area soils.

Soil fertility is naturally low within the survey area. Nitrogen, and to a lesser degree phosphorus are needed for best crop production in the irrigated areas. Zinc and Iron are the only nutrients known to be deficient in many of the soils (11, 12). Most irrigation water contains enough of the minor elements to meet the annual requirements of commonly grown crops.

Soil capability classifications used by the SCS are interpretive groupings made primarily for agricultural purposes. In this classification the arable soils are grouped according to their potentialities and limitations for sustained production of the common cultivated crops. Thus, the most productive soils under irrigation, have Class I capability ratings whereas those with limitations are rated with higher roman numerals. Class I soils have few, if any, limitations that restrict their use. Class II soils have some limitations and Class III soils have moderate limitations which reduce the choice of crops or require moderate conservation practices. Class IV, Class V, and Class VI soils have limitations, which make them generally unsuited for cultivation and limit their use largely to pasture or range. Potential flooding, uneven topography, excessive rock or tree cover, seasonal high water tables, drainage problems, inadequate depth to bedrock, excessive slope, and clay subhorizons are the reasons for poor ratings. The major irrigated soils within the Study Area are identified as Class II and Class III soils with minor areas rated as Class I, Class IV and Class VI.

Irrigation Practices in the Study Area

All methods of irrigation are suited for the soils within the Study Area, except where slope is a limiting factor. Furrow irrigation is most common.

Furrow irrigation is accomplished by gravity flow of water in narrow channels fed by a head ditch. Water seeps into the soils from the sides and bottom of the furrows. Water is introduced into each furrow by a siphon tube from the head ditch. Crops commonly irrigated in the area are alfalfa, corn, sugar beets, barley, and field beans.

Where slope is a limiting factor, contour ditches, corrugations, contour furrows, cross-slope furrows, and sprinklers are used. Rotating boom-type sprinklers are used in the Study Area on limited acreages. According to the Weld County Extension Service (13) there is a trend to replace furrow irrigation with sprinklers. The two major reasons for this trend are to increase water application efficiencies and to decrease labor cost.

Cropping Patterns

The irrigated farmland within the Study Area produces a wide variety of crops. The main crops are corn for grain and silage, alfalfa, sugar beets, and field beans. A common cropping system is a 3 to 4 year rotation of alfalfa followed by corn for grain, corn for silage, sugar beets, small grains or field beans. This type of rotation allows maximum use of available soil nutrients. Malt barley is also grown on limited acreage within the Study Area.

Most of the corn grown in the area is used for feed at commercial feedlots, farm feedlots, and dairies. Significant numbers of sheep and turkey are raised on the feed crops grown in the area (11). Sugar beets and malt barley crops are commonly contracted by Great Western Sugar Corporation and Coors Brewery, respectively.

A rotation of small grain and summer fallow is the main type of farming on the non-irrigated acreage. Wheat is the principal dry-farm crop, but barley and sorghum are also grown.

In the 27 year period from 1950 to 1977, Colorado Agricultural statistics (14) show an increase in the acreage planted in corn and wheat. Barley, field beans, sugar beets, and sorghum have gradually declined since 1950. However, during the same period of time yields per acre for all crops have increased. This may be attributed to more efficient farm management practices and advanced technology in agricultural practices.

Present Production and Yield

Production and yields for FRICO lands and lands along the South Platte that might be removed from production due to the project have been developed. Presented in Table A-3 are the estimated 1979 crop irrigated and nonirrigated acres in the FRICO Standley Lake Division. Listed in Table A-4 are the estimated crop yields and crop values for FRICO lands in 1979. The estimated value of crops produced from irrigated lands within the FRICO Standley Lake Division in 1979 is $2,164,000. According to recent information from FRICO, Standley Lake releases for 1979 will be approximately 14,425 acre-feet. Based on current farm headgate yields of approximately 60 percent of the release, the 1979 farm deliveries will be 8655 acre-feet. Therefore, the FRICO farmers gross productivity based on water deliveries is estimated at $250 per acre-foot of water delivered at the farm headgate.

Some of the options evaluated may result in the transfer of some water rights from land near the South Platte River to the FRICO Standley Lake Division to satisfy part of Northglenn's requirement to return 110 percent of the water borrowed from FRICO. Therefore, farm productivity along the South Platte lands that could be affected has been determined. Presented in Table A-5 is a summary of the crop values. The farm headgate delivery to these South Platte lands is 3,192 acre-feet. The estimated value of crops produced from irrigated lands near the South Platte in 1979 is $349,500. The gross productivity of those specific lands along the South Platte is therefore $109/acre-foot of water delivered to the farm headgate.

CLIMATE

The Front Range area around Denver is a transition area from plains climate to the climate of the foothills. This area is characterized as a high elevation continental, semi-arid climate.

Temperatures are typically moderate, with a mean monthly temperature of 10.1°C (50.2°F). Ranges in extremes have been recorded from -35.58°C (-30°F) to 40°C (104°F).

Annual average precipitation for the region is 37 centimeters (14.5 inches) with a large proportion of the rain falling from April to September. Thunderstorm activity accounts for much of this precipitation. Heavy thunderstorms in the foothills and plains areas occasionally cause damaging floods. The area has a low relative humidity which is a major factor in the areal potential evapotranspiration rate of 611 millimeters (24 inches). This amount is nearly twice the average precipitation and is an indication of the arid nature of the area. Periods of drought one to two years in length are common in portions of Adams County (12).

TABLE A-3

ESTIMATED DISTRIBUTION OF IRRIGATED AND NON-IRRIGATED AREAS WITHIN FARMERS RESERVIOR AND IRRIGATION CO., STANDLEY LAKE DIVISION IN 1979

	AREA (ACRES)*			PERCENTAGE OF TOTAL AREA		
CROP	IRRIGATED	NON-IRRIGATED	TOTAL	IRRIGATED	NON-IRRIGATED	TOTAL
Corn (Grain/Silage)	4,850	0	4,850	32	0	32
Alfalfa	1,970	0	1,970	13	0	13
Spring Wheat	0	1,033	1,033	0	7	7
Winter Wheat	0	834	834	0	5	5
Barley	767	700	1,467	5	5	10
Sugar Beets	606	0	606	4	0	4
Field Beans	152	0	152	1	0	1
Fallow	0	3,031	3,031	0	20	20
Dairy	0	62	62	0	1	1
Non-Agricultural	0	1,151	1,151	0	7	7
TOTAL	8,345	6,811	15,156	55	45	100

*Estimated from planimetering maps of cropping pattern in 1979 within Farmers Reservoir and Irrigation Co., Standley Lake Division.

TABLE A-4
ESTIMATED 1979 CROP VALUE
IN FRICO STANDLEY LAKE DIVISION

Crop	Yield Per Acre[1]	1979 Market Value[2]	Crop Acres	Crop Value[3] Irrigated	 Non-Irrigated
Alfalfa	4 ton	$ 49.50/ton	1970	$ 390,000	$
Corn (grain)	100 bu	2.74/bu	3395[3]	930,000	
Corn (silage)	16 ton	18.31/ton	1455[3]	426,000	
Sugar Beets	16.6 ton	29.00/ton	606	290,000	
Field Beans	27.5 bu	10.00/bu	152	42,000	
Barley (irrigated)	42.5 bu	2.64/bu	767	86,000	
Barley (non-irrigated)	16.5 bu	2.11/bu	700		24,000
Wheat (non-irrigated)	16.5 bu	3.76/bu	1867		116,000
			10,912	$2,164,000	$140,000

---

[1] Weld County County Extension Service.

[2] From Northern Feed and Bean, Western Alfalfa Corp, Farmers Marketing Association, Monfort Farms, Coors Brewery, Great Western Sugar Co.

[3] Assume 70 percent of corn to be harvested as grain and 30 percent as silage.

TABLE A-5

ESTIMATED CROP VALUE-SOUTH PLATTE RIVER
IN 1979 DOLLARS

Crop	Yield Per Acre[1]	1979 Market Values[2]	Crop Acres[3]	Crop Value Irrigated
Alfalfa	4.2 tons	49.50/ton	456	95,500
Corn (grain)	140 bu	2.74/bu	303	116,200
Corn (silage)	13.8 tons	18.31/ton	129	32,500
Sugar Beets	18.6 tons	29.00/ton	157	84,500
Field Beans	23.6 bu	10.00/bu	65	15,340
Barley (irrigated)	43.6 bu	2.64/bu	48	5,500
				349,540

[1] Estimated historic yields based on current market value of crops and information provided by Colorado Agricultural statistician, Lance Fretwell.

[2] Northern Feed and Bean, Western Alfalfa Corp, Farmers Market Association, Monfort Farms, Coors Brewery, Great Western Sugar Company.

[3] Wright-McLaughlin Engineers, Depletion Studies on the Fulton Ditch, Lupton-Bottom Ditch, and Burlington Ditch-Wellington Reservoir System.

Snowfall is generally not heavy, with most snow occurring between November and April. The growing season, or frost-free period is between April and September.

Wind data are summarized on the Annual Wind Rose (Figure A-8). Generally, the winds are out of the south. Occasionally upslope conditions prevail which follow the South Platte River drainage from the northeast (15). Downslope conditions are more complex but generally are from the northwest with some winds out of the southwest. Local wind patterns will vary seasonally and diurnally.

GEOLOGY

Subsurface and geologic conditions are identified at the proposed wastewater treatment facility and storage reservoir. Investigations have been conducted at the proposed site (16, 17) and reviewed. The existing subsurface and geologic conditions are summarized below:

Northern Adams County and southern Weld County are located at the northwest edge of the Denver Basin. This region of the basin is separated from the rest of the basin by the South Platte River. The Denver Basin is a large north-south trending asymmetrical, structured downwarp (18). The west side of the Basin has been folded and faulted by the uplifting of the Front Range.

The bedrock geology of the reservoir site area consists of the Dawson Group (Arapahoe Formation), the Laramie Formation, and the Fox Hills Sandstone.

The Late Cretaceous, Arapahoe Formation has been eroded away in this area with about 50 feet of the basal Arapahoe remaining (16). Some locations in the area are void of the Arapahoe as a result of faulting and erosion. This formation consists of interbedded sandstones and clay shales with occasional lenses of conglomerate.

The non-marine Laramie Formation (Late Cretaceous) underlies the Arapahoe and is about 600 feet thick. This formation consists of interbedded shales, siltstone, occasional sandstones and a few localized coal beds. The top of the Laramie is an erosional surface and is unconformably overlain by the Arapahoe Formation (16).

The Fox Hills Sandstone is the oldest of the three formations. It is a Late Cretaceous marine deposit of sandstones and shales. The top of the Fox Hills Formation is at a depth of about 650 feet.

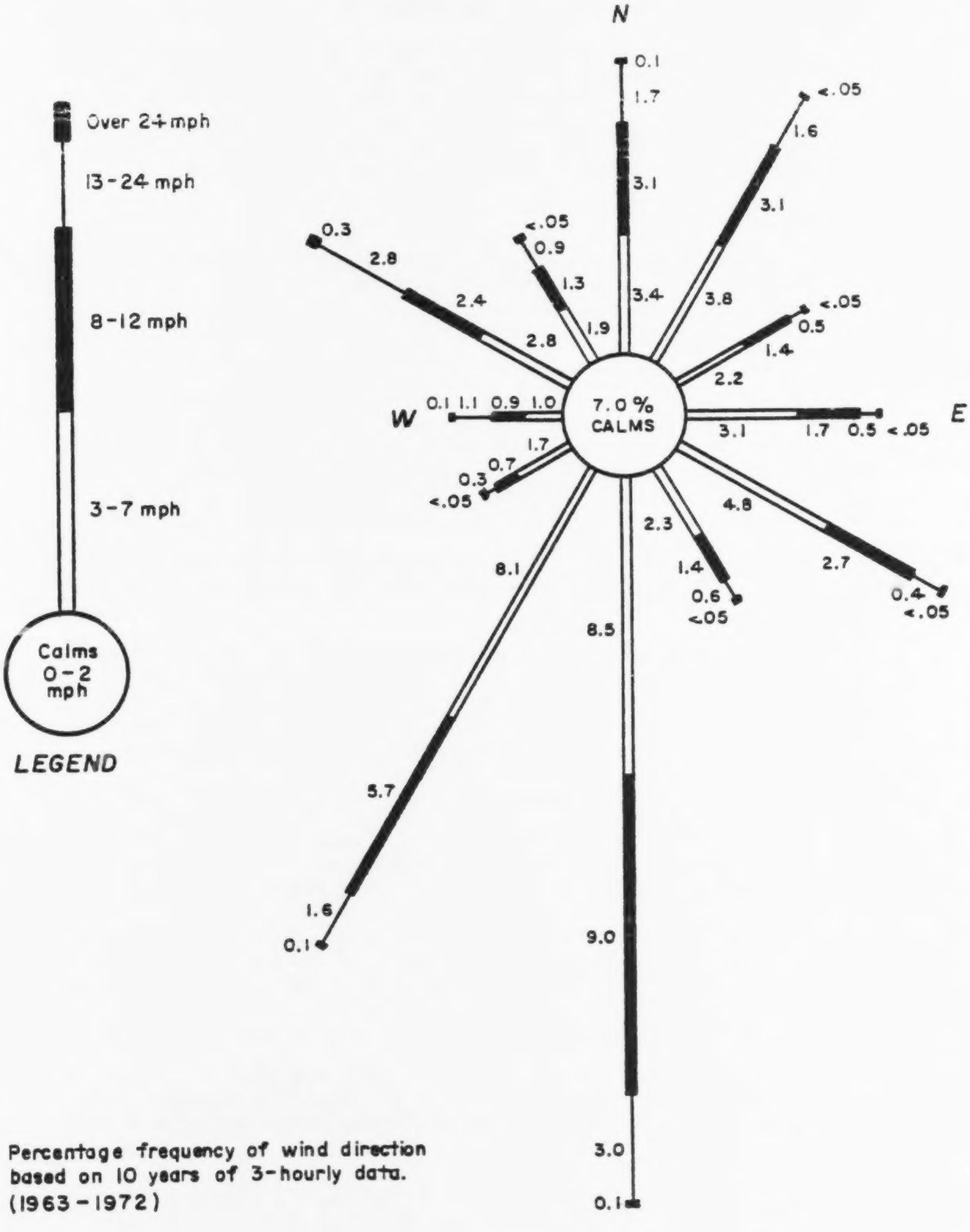
Faults and Earthquakes

The historic seismicity and geologic and tectonic history of the area has been reviewed to evaluate earthquake susceptibility (17). Faults in the area were formed with the deposition of the

FIGURE A-8

ANNUAL WIND ROSE

STAPLETON INTERNATIONAL AIRPORT
DENVER, COLORADO



Percentage frequency of wind direction based on 10 years of 3-hourly data. (1963-1972)

Laramie and Arapahoe Formations in Late Cretaceous time (16). These faults are classified as not potentially active and are not believed to present any danger of movement (16, 18).

However, the area is within the Denver Seismic Zone and is therefore subject to influence by seismic activity in the zone. The Denver Seismic Zone does not coincide with a major fault zone and surface fault ruptures have not been associated with historic earthquakes (17). This has resulted in the following conclusion (17):

> "The Denver Seismic Zone is a potential source of future earthquakes, however, judging from the lack of major faults in the area, it is unlikely that future earthquakes would exceed magnitudes greater than 5.5 to 6.0 (Richter Scale)."

Because there is a potential for future earthquakes, design features of any structure must account for earthquake stress. It has been recommended that facilities related to the Northglenn plan be designed for a maximum design earthquake that corresponds to a Modified Mercalli Intensity of VIII (17), which corresponds to a magnitude of between 6.1 to 6.7 on the Richter scale near the epicenter. This earthquake is based on what is considered to be a reasonable credible earthquake in the Denver earthquake zone.

ARCHAEOLOGICAL/HISTORIC RESOURCES

From February 28 to March 1, 1978, Dr. Dean Arnold, Department of Sociology-Anthropology, Wheaton College, Illinois, conducted an "Archeological Survey for the Area Affected by the Northglenn Water Management Program." At the conclusion of this survey, he determined that there were "no known significant archeological sites nor cultural resources that would be destroyed or adversely affected by the proposed project."

The only area of interest identified in this survey was an "historic dump of recent period probably 1900-1940 A.D.," which site was referred to as "5AM66." This site was located on the east side of the right-of-way of York Road, approximately 50 meters from the crest of the hill, in the general vicinity of the proposed site for the Northglenn force main. To avoid any interference with or impact on the 5AM66 site, the City of Northglenn has agreed to locate the force main on the west side of York Road, well away from that site.

In addition, Northglenn agrees to include in all construction contracts a provision requiring the contractor to halt construction should any archeological artifact be discovered, and to notify the City immediately. The City, in turn, will notify the State Archeologist's office prior to authorizing the recommencement of construction at the site. Should the State Archeologist's office request time to examine the site prior to recommencement of construction, Northglenn will provide this opportunity.

To summarize, the Archeological Survey has disclosed no areas of significance in the vicinity of the Northglenn sewage treatment facility. With respect to site 5AM66, the City will relocate its force main to avoid any impact on that site. Finally, the City will include in all construction contracts, a provision to halt construction to permit evaluation and protection of any artifacts with archeological or cultural significance.

APPENDIX B

LITERATURE REVIEW OF PUBLIC HEALTH RISKS

Shuval has recently reviewed general wastewater reuse considerations (1). He reported results of recent unpublished studies in Israel indicating that poliovirus inocculated in sewage could be detected in the soil and on cucumbers seven days after irrigation. These results, as well as others such as the cholera outbreak in Jerusalem in 1970 (2), were attributed to irrigation with sewage receiving only primary treatment without any disinfection. Aerosal dispersion studies of microorganisms (3) also indicate the importance of treatment process and controls in order to reduce health risks of water reclamation for irrigation.

The World Health Organization (4) suggests treatment processes for various reuse options. These options are summarized in Table B-1. Reuse of reclaimed water for irrigation of food crops, with the indicated processes and proper disinfection, are felt to be essentially free of health hazards. The key requirement is proper disinfection which is defined as: "the art of killing the larger portion of microorganisms. . .with the probability that all pathogenic bacteria are killed" (5). Chlorination of ordinary wastewater usually does not kill all pathogenic organisms, especially viruses. However, recent work at the University of California at Berkeley (6) and at Pomona, California (7) indicates that virus inactivation is possible through in-depth filtration (to remove micro-particulates) and maintenance of a chlorine residual in the effluent for at least two hours.

Based on the experience cited, it is clearly important to note the conditions involved before relating them to the proposed Northglenn project.

Waterborne Diseases and Outbreaks

Many surveys on waterborne disease causing organisms have been published (8, 9, 10, 11, 12 and 13). A summary list of diseases that are potentially transmitted by food contaminated with wastewater and/or fecal material is presented in Table B-2. Parasites that cause hookworm, schistosomiasis and leptospirosis, which are transmitted from human wastes and are capable of penetrating human skin, are a potential health problem to farm workers (8).

Viruses. A report by Taylor provides an overview of the virus problems stating the types of viruses found in water and the diseases they cause (13). Viral diseases that have been linked to sewage include polio, menengitis and infectious hepatitis (11). The infectious hepatitis virus has not yet been isolated from any source media. Information concerning infectious hepatitus is inferred from epidemiological data and other tests on human subjects (14).

TABLE B-1

SUGGESTED TREATMENT PROCESSES TO MEET THE GIVEN HEALTH CRITERIA FOR WASTEWATER REUSE[a]

Health Criteria[b]	Irrigation			Recreation			Municipal Reuse	
	Crops Not for Direct Human Consumption (A + F)	Crops Eaten Cooked; Fish Culture (B + F or D + F)	Crops Eaten Raw (D + F)	No Contact (B)	Contact (D + G)	Industrial Reuse (C or D)	Non-Potable (C)	Potable (E)
Primary Treatment	∘∘∘	∘∘∘	∘∘∘	∘∘∘	∘∘∘	∘∘∘	∘∘∘	∘∘∘
Secondary Treatment		∘∘∘	∘∘∘	∘∘∘	∘∘∘	∘∘∘	∘∘∘	∘∘∘
Sand Filtration or Equivalent Polishing Methods		∘	∘		∘∘∘	∘	∘∘∘	∘∘
Nitrification						∘		∘∘∘
Denitrification								∘∘
Chemical Clarification						∘		∘∘
Carbon Adsorption						∘		∘∘
Ion Exchange or Other Means of Removing Ions								
Disinfection		∘	∘∘∘	∘	∘∘∘	∘	∘∘∘	∘∘∘[c]

---

[a] Reproduced with the permission of the World Health Organization from Reuse of Effluents: Methods of Wastewater Treatment and Health Safeguards. WHO Technical Report Series No. 517, Geneva, 1973.

[b] Health criteria: A Freedom from gross solids; significant removal of parasite eggs. B as A, plus significant removal of bacteria. C as A, plus more effective removal of bacteria, plus some removal of viruses. D Not more than 100 coliform organisms per 100 ml in 80% of samples. E No fecal coliform organisms in 100 ml, plus no virus particles in 1,000 ml, plus no toxic effects on man, and other drinking-water criteria. F No chemicals that lead to undesirable residues in crops or fish. G No chemicals that lead to irritation of mucous membranes and skin. In order to meet the given health criteria, processes marked ∘∘∘ will be essential. In addition, one or more processes marked ∘∘ will also be essential, and further processes marked ∘ may sometimes be required.

[c] Free chlorine after 1 hour.

TABLE B-2

DISEASES AND CAUSATIVE AGENTS TRANSMISSIBLE BY FOOD THAT HAS BEEN CONTAMINATED BY WASTEWATER OR BY SOIL THAT CONTAINS FECAL MATERIAL (8)

Disease	Agent
Bacteria[a]	
Arizona infection	*Arizona hinshawii*
Bacillus cereus gastroenteritis	*Bacillus cereus*
Cholera[b]	*Vibrio cholerae*
Clostridium perfringens gastroenteritis	*Clostridium perfringens*
Enteropathogenic *Escherichia coli* infection	*Escherichia coli* (certain serotypes)
Paratyphoid fever[b]	*Salmonella paratyphi* A
	Salmonella paratyphi B
	Salmonella paratyphi C
	Salmonella sendai
Pseudotuberculosis	*Pasteurella pseudotuberculosis*
Salmonellosis[b]	*Salmonella* (over 1,500 serotypes)
Shigellosis[b]	*Shigella sonnei*
	Shigella flexneri
	Shigella dysenteriae
	Shigella boydii
Typhoid fever[b]	*Salmonella typhi*
Yersinia gastroenteritis	*Yersinia enterocolitica*
Viruses	
Adenovirus infection	Adenoviruses
Coxsackie infection	Coxsackie viruses
ECHO virus infection	ECHO viruses
Poliomyelitis	Polioviruses
Reovirus infection	Reoviruses
Viral hepatitis[b]	Hepatitis virus A
Winter vomiting disease	Norwalk agent
Helminths	
Ascariasis[b]	*Ascaris lumbricoides*
Trichiniasis	*Trichuris trichiura*
Protozoa	
Amebiasis[b]	*Entamoeba histoyltica*
Balantidiasis	*Balantidium coli*
Coccidiosis (*Isospora* infection)	*Isospora belli*, *I. hominis*
Dientamoeba infection	*Dientamoeba fragilis*
Giardiasis	*Giardia lamblia*

---

[a] Other enteric bacteria which could conceivably be transmitted by foods but proof is inconclusive: *Streptococcus faecalis*, *s. faecium*, *Proteus* spp., *Providencia* spp., *Citrobacter freundii*, *Enterobacter* spp., *Edwardsiella* spp., *Aeromonas* spp., *Pseudomonas aeruginosa*.

[b] Reported outbreaks.

Inactivation of the infectious hepatitis virus depends on the level of water treatment and disinfection. Work by Young (15) shows that out of 28 cases reported by Mosely, only four occurred where complete treatment was available. Of those, one occurred after treatment was by-passed, one lacked the evidence to implicate conclusively the water supply, another resulted when a concentration of 0.8 mg/l of chlorine was being applied to the water with no record of a 30-minute residual, and the last happened where chloramines were used for disinfection and plant records were inadequate to allow analysis.

McDermott reports virus in 5 out of 32 samples in the finished water of one community and in 2 out of 32 samples in another community (12). The infectious dose required to cause disease in humans by viruses is unknown but is recognized as significantly less than that dose required for bacterial infectious diseases.

Aerosol Transmission of Pathogens. One concern at sewage treatment plants is the health hazard posed by aerosols from the wastewater. In a survey by Hickey and Reist (16) the increase in likelihood of contracting a respiratory disease because of working at a wastewater treatment plant was reported to be insignificant. The number of Klebsiella inhaled at a treatment plant are about one-eighth that needed to produce infectious disease. Although inconclusive, the incidence of pneumonia in workers at both water and wastewater treatment plants was reported to be the same. Data concerning influenza and colds were not conclusive.

Sorber (17, 18) has shown in pilot plant studies that aerosols can disperse pathogens found in domestic sewage. A decrease in the number of inhaled infectious viral units occurred with a corresponding decrease in infectious viral units in the sewage. The viricidal effect of sunlight and higher temperatures was found to be definite, although the effect of relative humidity varied with different types of virus. In aerosols, the majority of bacteria die off in the first three seconds of exposure while some persist.

A review by Stanford and others (19) analyzed the morbidity risk factors associated with spray irrigation of wastewater. The authors state that a literature search has not revealed any incidence of disease from irrigation with properly treated sewage (e.g., chlorinated secondary effluent). They also state that the formation of droplets smaller than 500 microns in diameter should be prevented.

Katzenelson (3) presented data on aerosol hazards due to spray irrigation with contaminated river water and aerated lagoon effluent. Coliform bacteria and Salmonella were found 350 meters and 60 meters (1,150 and 200 ft), respectively, from the sprinklers when contaminated river water was used. Only coliform bacteria were found in tests on aerosols from an aerated lagoon, and these were at a maximum distance of 30 meters (100 ft) from the sprinkler sites.

Irrigation with Wastewater Effluent. A committee organized by the Sanitary Engineering Division of the American Society of Civil Engineers stated that no outbreaks of disease due to crop irrigation with secondary effluent had been reported with the systems in use up to 1970 (20). However, a number of outbreaks have been associated with various types of foods contaminated with wastewater, some as a result of irrigation. One outbreak resulting from contaminated vegetables occurred with the use of unchlorinated secondary effluent. All other outbreaks were connected with water treated to a lesser extent (8).

Katzenelson (21) demonstrated the hazards of using partially treated nondisinfected oxidation pond effluent for irrigation. A survey of the incidence of shingellosis, salmonellosis, typhoid fever and infectious hepatitis showed that these diseases were two to four times more prevalent in communities where spray irrigation was practiced than in others. Unconfirmed cases of influenza also occurred twice as often where spray irrigation with oxidation pond effluent was used. However, no sigifnicant difference in disease incidence was noted during the winter nonirrigation season.

One of the main hazards of irrigating crops with poorly treated sewage is the possible spread of infectious hepatitis. Neefe and Stokes demonstrated that the infectious hepatitis virus is transmitted in the feces of humans. In another article by the same author (14), the effects of the infectious hepatitis virus were shown to be much less severe after exposure of effluent to high concentrations of chlorine, but only partially diminished after treatment by aluminum sulfate or activated carbon.

Survival of Pathogenic Organisms in the Environment

Bacteria. A review by Sepp (23) includes discussion of the survival time of many organisms where wastewater is used for irrigation. Extremely long survival times of such agents as Ascaris eggs and Salmonella necessitate their elimination during wastewater treatment.

The major factors that influence bacterial survival in soil are soil type, moisture, pH, sunlight, and temperature (24). pH values between 2.9 and 4.5 inactivate most bacteria, whereas less inactivation occurs with pH values between 5.8 and 7.8. Sunlight tends to inhibit bacterial growth, while (within the ranges normally encountered) bacterial survival increases with increasing moisture and temperature. Bacterial die off however can be reduced with colder temperatures. Monitoring data from lagoon systems in North Dakota indicate the highest levels of fecal coliform occur during the winter.

The summary provided by Gerba et al (24), describes several experiments on the movement of coliform bacteria through soil. In all cases the die-off of the coliform bacteria from secondary effluent was substantial after movement of the effluent through 6 meters to 10 meters (20 to 30 ft.) of soil.

Virus. Fujioka and Loh (25) indicate the poliovirus can survive for 32 days in soil irrigated with secondary effluent. Experiments by Leffler and Kott (26) demonstrated longer survival times for bacteriophage f2 than for poliovirus. In sand saturated with both tap water and oxidation pond effluent, f2 was detected after 175 days, whereas poliovirus was not detected after 91 days. Bitton (27) reviewed studies on virus movement through soil.

Duboise et al (28) demonstrated differences in the penetration rates of viruses through soils resulting from the use of intermittent instead of continuous flows. Young and Burbank's work with Hawaiian soils showed that poliovirus passed through columns in which coliphage T4 was trapped (29). Using coliphage T2 and poliovirus, Bitton (30) presented evidence that secondary effluent caused desorption of viruses from soils particles. Interference by the organic matter present in the secondary effluent was suggested as the reason for desorption.

Most of the cases of viral and pathogen contamination of food crops have occurred with irrigated crops (8). Studies by Bagdasaryan (31) indicated that survival of enterovirus on vegetables is dependent on temperature. A 99.6 percent die-off in ten days was noted with tomatoes at a temperature of 18° to 21°C (64° - 69°F), compared with a 90 percent loss when kept for ten days at 4° to 10°C (39° - 50°F).

Larkin et al (32) grew vegetables in plastic-lined wooden boxes, spraying them with virus-laden sludge and effluent. The vegetables were allowed to weather extensive periods of direct sunlight, high temperatures and periodic rainfall. Though 99 percent of the seeded polio was inactivated during the first five to six days, virus still could be detected on the lettuce and radishes after 36 days in one test and after 14 days in another. Other tests using oxidation pond effluent were conducted by Kott and Fishelson (33). Under conditions of greater than minimal sunlight, no virus could be detected on the vegetable surface after 28 hours.

Drewry and Eliassen (34) concluded that virus movement through soils under saturated conditions should present no real health hazard to ground water supplies. However, studies by Wellings, et al (35, 36) show that virus can remain infective after aeration, sunlight and percolation through 20 feet of sandy soil. Wellings also demonstrated vertical and lateral movement of virus, as well as survival in sandy soil for 28 days during a period of heavy rains. Due primarily to analytical difficulties, data concerning the mobility and survival rates of infectious hepatitis is limited.

Removal of Pathogens by Treatment Processes

Different levels of pathogen removal by various treatment processes should be considered when using reclaimed water. Bryan (8) discussed the removal of a wide variety of bacteria and virus by processes in sewage treatment plants. Malina (37) analyzed more specifically virus removal by processes in both water and wastewater treatment plants.

Primary Sedimentation. Primary sedimentation normally removes less than 50 percent of the pathogenic bacteria from sewage (8). The wide variation in virus removals documented is probably due to variations in the concentrations of incoming suspended solids (37). Viruses are known to adsorb to suspended solids and, hence, be much less detectable in an analysis of the liquid phase. This does not necessarily imply that their ability to infect is altered (38).

Biological Treatment. Biological treatment normally removes about 90 percent of the pathogenic bacteria (8). The different types of biological treatments vary somewhat in their ability to remove virus. Activated sludge and aerated lagoon systems are the two most effective. Both can remove more than 90 percent of the incoming viruses. Careful operation can achieve removals of greater than 98 percent (37).

In another study by Malina (39), the sensitivity of virus removal to changes in different parameters of the activated sludge process was examined. Virus inactivation was found to be independent of 1) organic loading 2) hydraulic detention times and mixed liquor suspended solids concentrations, and 3) whether oxygen or air was used in the process. Virus adsorption to sludge was found to be almost immediate. It was determined also that inactivation in the process occurs in a time-stable sludge-virus complex. Further information concerning virus inactivation in activated sludge can be found in several other publications (19, 25, 40, 41).

Disinfection. Various disinfecting agents have received attention (21, 42, 43, 44, 45, 46, 23, 24, 25, 26, 27), but chlorine remains the most widely used. Several factors influence the effectiveness of chlorine in deactivating pathogens. These are discussed in an article by Culp (47) and are: 1) pH and the concentration of hypochlorous acid present; 2) detention time; 3) turbidity or solids content (the lower the concentration of particulate matter, the more effective is disinfection); 4) presence of oxides of iron, ammonia, manganese and hydrogen sulfide; 5) presence of organic compounds; 6) temperature; and, 7) mixing.

Effective disinfection of wastewater with chlorine generally requires a good quality effluent, (e.g. 30/30 BOD and suspended solids) good mixing, adequate contact time and chlorination to the breakpoint to obtain a free chlorine residual.

The use of ozone as a disinfectant has recently been given increased consideration. In a comparison of ozone with chlorine (46), it was noted that ozone oxidizes phenols, cyanides and pesticides more completely than does chlorine. It also is unaffected by the presence of ammonium. Disadvantages of its use are lack of residual, cost and high sensitivity of bactericidal effectiveness to method of application.

Coagulation. Various studies with coagulation-flocculation processes have concluded that this is the most effective method of virus inactivation in water treatment plants besides disinfection (43).

Removals of greater than 99 percent have been recorded often (30, 31, 32, 48, 49, 50, 51, 52).

Chudhuri (53) concluded that coagulation-flocculation could not be expected to operate with high virus removal efficiency in wastewater because of the presence of organic matter. This conclusion contradicts the findings of Sobsey et al (54), who showed that 99.95 percent of seeded influent virus were removed from raw sewage by a packaged wastewater treatment system using alum flocculation. Sobsey et al concluded that alum flocculation and activated carbon adsorption with subsequent removal by diatomaceous earth filtration were functionally more important than chlorine in removing virus when raw sewage was processed. Later tests on secondary effluents by Wolf et al (52) showed greater than 99.7 percent removals obtained in a large-scale pilot study.

Sand Filtration. Rapid sand filtration in conjunction with flocculation is an effective means of removing virus. Sand filtration is used in wastewater treatment to remove cysts and Ascaris eggs (8).

Carbon Adsorption. Carbon adsorption has been considered an effective means of removing virus from water. Tests show that over 90 percent removal is possible. However, one conclusion about this process may preclude dependence on carbon adsorption for virus reduction. Gerba et al (43), found that when the capacity of the carbon column to adsorb virus is reached, desorption may occur with the replacement of virus by organic substances. Such an occurrence could cause a surge of viruses to enter the distribution system, resulting in a highly virus-laden effluent.

APPENDIX C - DETAILS OF EPA
FUNDING ANALYSIS
COSTS FOR TREATMENT AT DENVER METRO

DISCUSSION

Metro Effluent Limitations

The level of treatment for Denver Metro which will be used in the analysis is based upon the effluent limitations that are given in the National Pollutant Discharge Elimination System (NPDES) permit for Denver Metro as "Future Effluent Limitations." These limits are:

Parameter	30 Consecutive Day Period	7 Consecutive Day Period	Instantaneous
BOD - mg/l	20	30	
Total Suspended Solids-mg/l	20	30	
Fecal Coliforms-Organisms/100 ml	1,000	2,000	
Ammonia Nitrogen-mg/l	1.5	1.5	
Total Residual Chlorine-mg/l	-	-	0.05
Oil and Grease-mg/l	-	-	10
Dissolved Oxygen	-	-	6.4(min)
pH units between 6.0 and 9.0	-	-	-

The NPDES permit effluent limitations were based upon the wasteload allocation which was part of the South Platte River 303(e) Water Quality Management Plan. The wasteload allocation set the effluent requirements at a level necessary to protect water quality in order to maintain the South Platte River's B2, warm water fishery classification.

At present, the Colorado Water Quality Control Commission is in the process of reclassifying all water bodies in Colorado. The South Platte River will be assigned use classifications. Potential use classifications which could be applied to the South Platte River at the Denver Metro Plant include secondary contact recreation, agriculture, warm water aquatic life class 1, warm water aquatic life class 2 and domestic water supply class 2. Effluent limitations for dischargers will be set at a level to protect the uses for which the River will be classified.

Since at this time there is uncertainty as to the use classifications that will be placed upon the South Platte River and therefore the effluent requirements, it was decided by EPA that the effluent limits in the NPDES permit for the Denver Metro facility shall be used in the determination of the necessary level of treatment at Denver Metro. These limitations are taken from the most recent approved wasteload allocation based upon existing classifications.

Operation and Maintenance (O&M) Costs, Denver Metro

EPA Region VIII was instructed by EPA Headquarters to use the prorated costs of Northglenn's share of the O&M costs at Denver Metro.

The present worth of the O&M costs for the 20-year project will be determined using the mid-period year (1990) operation and maintenance expenses as the annual cost. Therefore, the share of the cost that will be attirbuted to Northglenn shall be 4.45/165 times the present worth of the O&M costs. 4.45 mgd is the 1990 projected flow for the Northglenn facility and 165 mgd is the 1990 projected flow for the Denver Metro facility.

The annual O&M cost was determined using information from the 1980 Denver Metro Budget (1), the "Phase 1 Report, Central Plant Facility Plan" (Denver Metro Facility Plan) (2), and the plan for the proposed Metro Denver Central Plant, Adams Co. Sludge Recycling Facilities. The annual O&M cost for secondary treatment was taken from the 1980 Denver Metro Budget and was prorated and projected to show the cost for treating Denver Metro's flows in 1990. The costs for bond retirement and the costs of the existing solids disposal system were subtracted out.

Expansion and Upgrade at Denver Metro, Capital Cost Breakdown

The Denver Metro Facility Plan concluded that there is sufficient primary treatment capacity to treat flows at Denver Metro until the year 2004. This conclusion had been qualified; additional studies were recommended on the peaking flow conditions for the primary facilities. For the Northglenn cost analysis, it has been assumed that additional primary treatment capacity will not be required, therefore no capital expense will be used for this item.

The facility plan rated the capacity of the existing "secondary facilities" to be at 132 mgd. At this capacity, the facility plan states that the plant could meet the effluent limits of 20 mg/1 BOD_5 and TSS.

The facility plan specified a number of recommendations to bring the flow capacity up to 185 mgd for the design year 2004.

Several of the recommendations represented changes in the Denver Metro plant that related to improvements in the operability of existing facilities and were not related to increasing the flow capacity of the plant. These costs were therefore not included as costs of treating Northglenn's flows at Denver Metro. These items and costs were:

Immediate pilot work and investigations
Cost $350,000

Additional automation of North Complex activated sludge
Cost $150,000

Provide an improved aeration basin dewatering system
Cost $20,000

Install South Complex standby waste sludge pumps
Cost $50,000

Modification of South Complex secondary clarifiers and flow distribution system
Cost $500,000

Addition of rapid mixing chambers for chlorination system
Cost $100,000

Modification of existing North Complex chlorine contact basin to reduce short circuiting
Cost $100,000

A group of items in the list of recommended improvements for the Denver Metro plant were determined to be related to an increase of the flow capacity but their costs could not be broken down in order to show the incremental costs for the additional capacity which would be necessary to accomodate the Northglenn flows. These capital costs were therefore split out using a pro rata basis. The Northglenn share was determined to be the ratio of Northglenn's design flow divided by the total flow increase of the upgrade, 4.64 mgd/53 mgd. The items and their total capital costs are given:

Upgrade or replace the aeration system in the North Complex
Cost $2,500,000

Upgrading of the North Complex secondary clarifiers
Cost $2,000,000

Upgrading of the anaerobic digester mixing system to a mechanical mixing system
Cost $1,500,000

Conversion of the existing anaerobic digestion system to a dual digestion system
Cost $4,000,000

An item that was listed was the modification of the anaerobic digester gas collection system and increasing the capacity of the waste gas flare system. One half of this cost was attributed to the increase of capacity of the digesters. Therefore, one half of the cost was multiplied by the pro rata ratio 4.64/53. The total cost of this item is $200,000.

The addition of a final effluent reaeration and foam control basin was recommended. This item would be used to handle the total plant flow. The Northglenn cost of this item was therefore taken out as the incremental cost of the Northglenn flow to the total wastewater treatment flow. The total cost of this item is $1,100,000.

The Denver Metro Facility Plan included a cost estimate for upgrading the plant to meet advanced secondary treatment requirements through nitrification, breakpoint chlorination, and dechlorination.

The nitrification process would be performed using two different types of units. In the North Complex of the plant, combined stage nitrification would be done using a modification of the existing aeration basins. Separate nitrification units would be added to the secondary facilities in the South Complex. The capital cost of modifying the North Complex aeration basin to perform both secondary treatment and nitrification is considerably less than the capital cost of the separate stage nitrification that will be added to the South Complex. The incremental cost of the addition of the capacity for Northglenn's flows will be the cost of the addition of 4.64 mgd to the 65 mgd separate stage nitrification units.

The level of treatment that the Denver Metro Facility Plan provided for was less stringent than the level required by the NPDES permit for Denver Metro. Since it can be expected that operation of the proposed breakpoint chlorination system can be performed to attain this higher level of treatment, the Facility Plan costs were considered adequate.

EXPANSION AND UPGRADE AT DENVER METRO

Costs Determined on Pro rata Basis

Upgrade North Complex aeration system	$ 2,500,000
Upgrade North Complex secondary clarifiers	2,000,000
Upgrade anaerobic digester mixing system	1,500,000
Modification of anaerobic digester gas collection system and increase capacity of waste gas flare system	100,000
Conversion of existing anaerobic digestion system to dual digestion system	4,000,000
Total Cost	$10,100,000

Pro Rata Cost

$\frac{4.64 \text{ mgd}}{53 \text{ mgd}}$ (10,100,000) = 884,226

*884,226 x 1.07 = 946,122

946,000

*The factor 1.07 is included to correct the cost estimate for inflation

All costs equipment 20 year life no salvage value.

Costs Determined on Incremental Cost Basis

Reaeration

Cost equation taken from Figure 6-17, "Construction Costs for Municipal Wastewater Treatment Plants 1973-1977" (3).

$C = 2.27 \times 10^5\ Q^{0.87}$

Ratio $\frac{C_1}{C_2} \quad \frac{2.27 \times 10^5\ 165^{0.87}}{2.27 \times 10^5\ 169.64^{0.87}} = .9762$

Capital Cost = 1,100,000

.0238 (1,100,000) = 26,224

Salvage Value - Assume 50 year life for basin
Assume basin cost 1/2 capital cost 13,112

Present Worth (PW) salvage (.6)(13,112)(.2645) = 2,081

26,224 - 2,081 = $24,143

24,143 x 1.07 = 25,883 OR $26,000

Nitrification Facility

Cost equation from EPA 1973 Report "Cost Effective Wastewater Treatment Systems" (4)

Equation $C = 210,055 + 59204.6Q$

Ratio $\frac{C_1}{C_2} = \frac{210,055 + 59,204.6\ (65)}{210,055 + 59,204.6\ (69.64)} = .936$

(1 - .936) = 0.634

Capital Cost = 12,000,000

.0634 (12,000,000) = 760,800

Salvage Value - Assume 50 year life of basins
Assume basins 50% of costs

PW = .6 (760,800)(.5)(.2645) = 60,369
760,800 - 60,369 = 700,431
700,431 x 1.07 = 749,461
or 749,000

Breakpoint Chlorination

Cost equation from EPA 1973 Report "Cost Effective Wastewater Treatment Systems"

Equation $C = 136,587\ Q^{0.52}$

$\frac{C_1}{C_2} = \frac{185^{.52}}{189.64^{.52}} = .9872$

1 - .9872 = .01280
.01280 (700,000) = 8959
No Salvage Value

8,959 x 1.07 = $9,586
or $10,000

Dechlorination

Use same cost equation as for Breakpoint Chlorination

$$\frac{C_1}{C_2} \quad \frac{165^{.52}}{169.64^{.52}} = .9872$$

1 - .9872 = .01432

.01432 (500,000) = 7,160
7,160 x 1.07 = 7,661
or $8,000

Total Capital Costs Present Worth 1984 Construction Date

Construction Costs (calculation pro-rata basis)	$ 946,000
Reaeration Facility	26,000
Nitrification Facility	749,000
Breakpoint Chlorination	10,000
Dechlorination	8,000
Total	$1,739,000

Adjust to 1980 present worth

1,739,000 (.76647) 1,332,891

Total Costs

Annual O&M STP	$ 307,689
Annual O&M Sludge	75,700
Total	$ 383,389
PW = 10.6976 x 550.00	$4,101,342
PW O&M	$4,101,342
PW Capital	1,332,891
Total Treatment Cost	$5,434,233
Rounded	$5,434,000

Costs of Conveyance of Wastewater to Denver Metro

Discussion

The existing interceptor system that conveys wastewater from Northglenn and surrounding areas is shown in Figure C-1. Using DRCOG population estimates, the projected wastewater flows for the "Agricultural Reuse Service Area", shown in Figure C-1 are given.

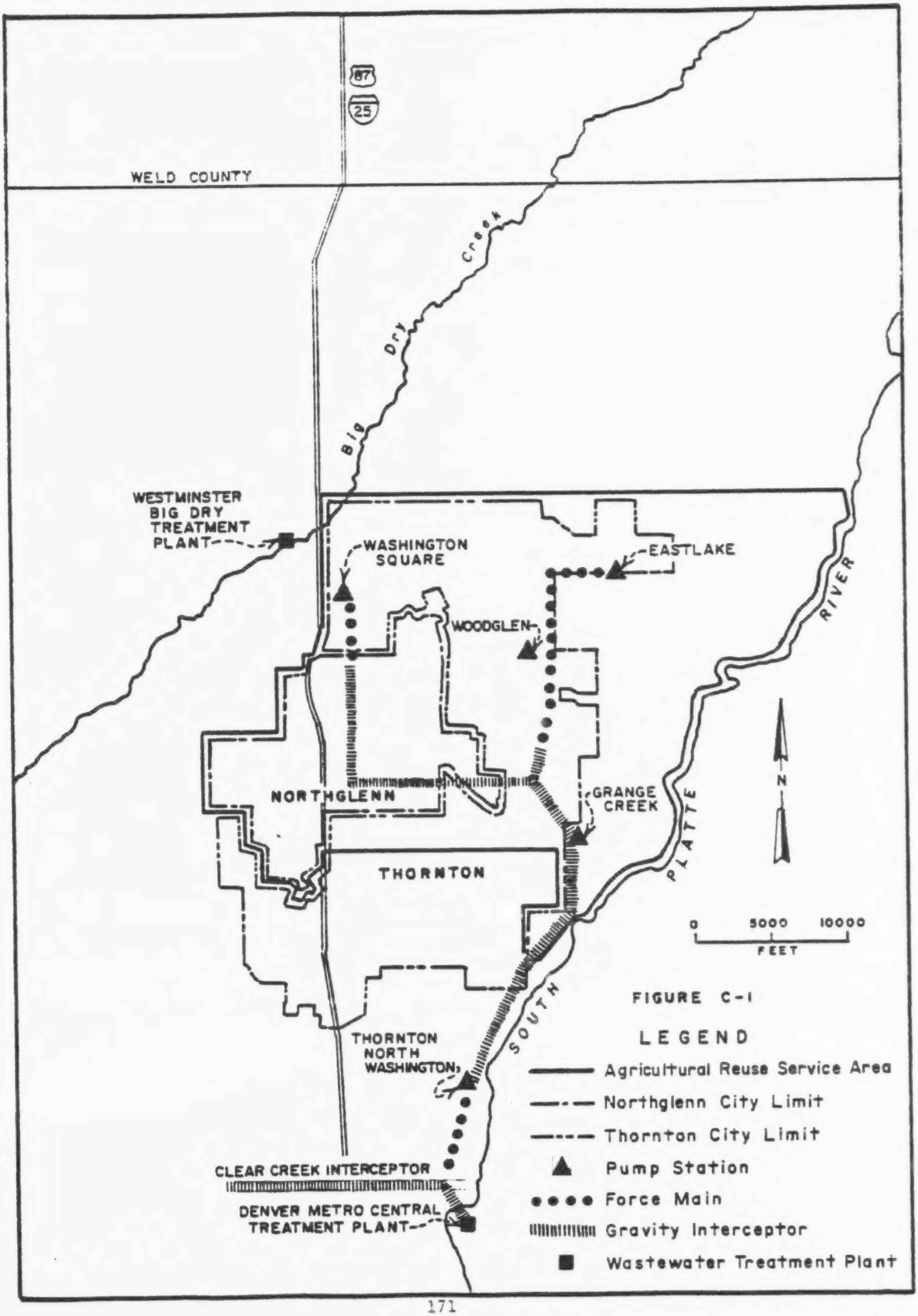

87
25
WELD COUNTY
Big Dry Creek
WESTMINSTER BIG DRY TREATMENT PLANT
WASHINGTON SQUARE
EASTLAKE
WOODGLEN
NORTHGLENN
GRANGE CREEK
THORNTON
SOUTH PLATTE RIVER
N
0
5000
10000
FEET
THORNTON NORTH WASHINGTON
CLEAR CREEK INTERCEPTOR
DENVER METRO CENTRAL TREATMENT PLANT
LEGEND
Agricultural Reuse Service Area
Northglenn City Limit
Thornton City Limit
▲ Pump Station
● ● ● ● Force Main
Gravity Interceptor
■ Wastewater Treatment Plant

FIGURE C-1

	1980	1990	2000
Total flow (million gallons per day)	4.74	6.24	7.00
Flows proposed for treatment with Northglenn System	3.59	4.45	4.65
Flows remaining for treatment at Denver Metro	1.15	1.79	2.35

Using flow estimates for the existing service areas, it has been projected that the Thornton-North Washington pump station would have its capacity exceeded by 1985 (5). It also has been projected that the capacity of the Thornton-North Washington interceptor which extends from 100th Avenue to the Thornton-North Washington pump station will be exceeded by 1985. The Thornton-North Washington force main, which conveys flow from the Thornton-North Washington pump station, is expected to have sufficient capacity until the year 2000. The flows are conveyed from the Thornton-North Washington force main to the Denver Metro sewage treatment through the Clear Creek Inverted Siphon. The Clear Creek Siphon will have to be enlarged during the planning period due to increased flows from the Clear Creek basin regardless of Northglenn's plan.

If Northglenn's flows are to be treated at Denver Metro for the planning period, changes would be required in the existing system to handle the projected flow increases. The interceptor system shown in Figure C-2 is the system used in the cost comparison as the facilities which would be necessary for the conveyance of the flows from Northglenn and the surrounding area. Using the system, .90 mgd of Northglenn's flow would be conveyed through the existing Thornton-North Washington Pump Station and Force Main. The remainder of 3.74 mgd of Northglenn's flow would be conveyed using the South Platte Interceptor and the Henderson Pump Station and Force Main. Along with Northglenn's flow, wastewater from parts of Thornton would also be conveyed in the system. These flow quantities are 1.31 mgd in the South Platte Interceptor and 2.36 mgd in the Henderson Pump Station and Force Main. The cost of the construction of the conveyance system which was assigned to Northglenn in the cost analysis is the ratio of the Northglenn flow over the total flow multiplied by the total construction cost. The operation and maintenance costs were also determined on a pro-rata basis using flow quantities.

Wastewater Conveyance Costs Treatment at Denver Metro

South Platte Interceptor 15" gravity sewer

$\frac{3.74 \text{ mgd}}{3.74 + 1.31}$ 905,100 (Total Cost)	$ 670,312
Construction Cost	670,312
Contingencies (25%)	167,578
Salvage Value (6) (.2645) 837,890	(132,973)
O&M 17,800 x 10.6976	190,400
Engineering Design & Construction Inspection	83,800
Administration & Overhead 3,600 x 10.6976	38,500
	1,017,617
	or 1,018,000

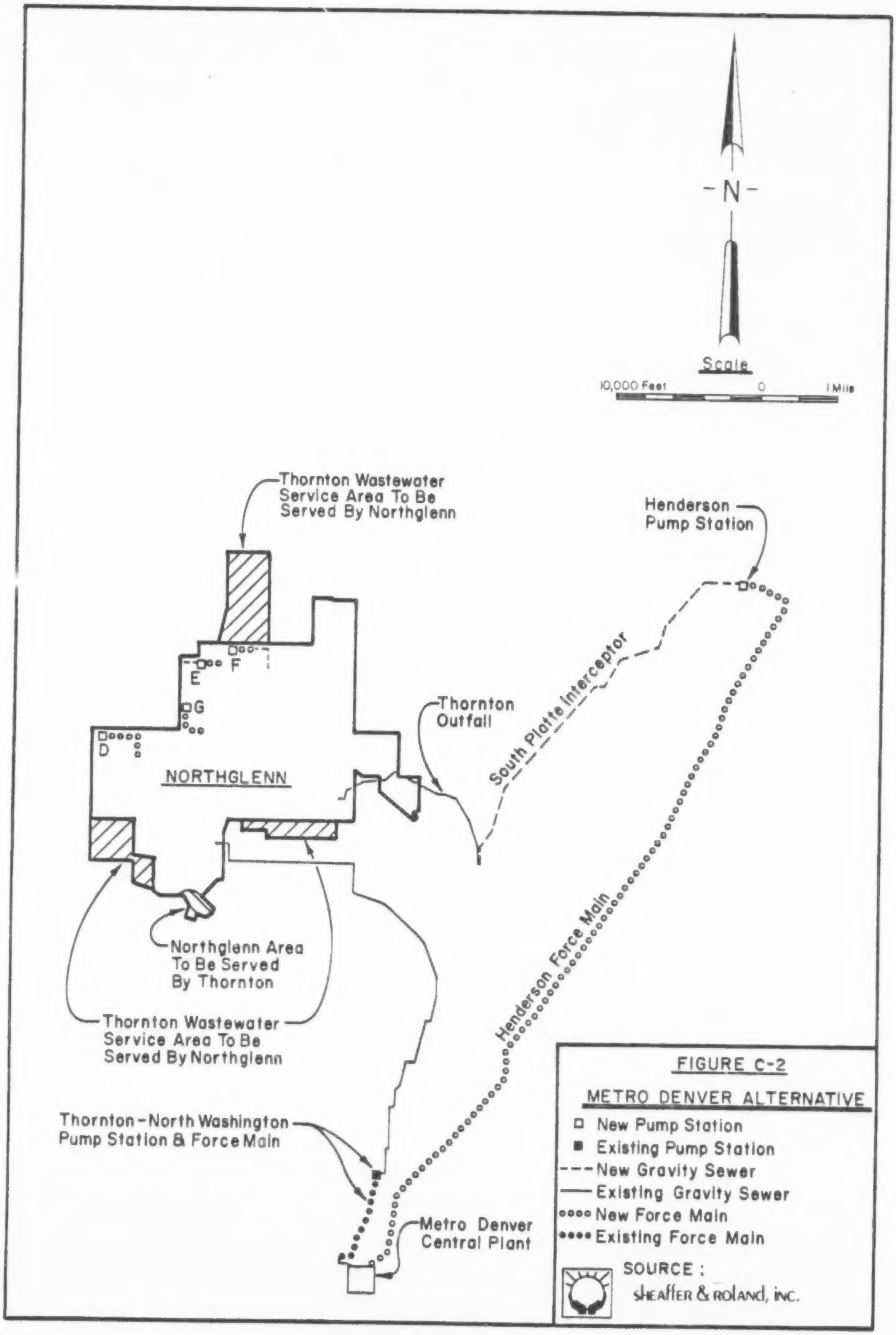


FIGURE C-2

METRO DENVER ALTERNATIVE

-N-
Scale
10,000 Feet
0
1 Mile
Thornton Wastewater Service Area To Be Served By Northglenn
Henderson Pump Station
South Platte Interceptor
Thornton Outfall
E
F
G
D
NORTHGLENN
Henderson Force Main
Northglenn Area To Be Served By Thornton
Thornton Wastewater Service Area To Be Served By Northglenn
Thornton-North Washington Pump Station & Force Main
Metro Denver Central Plant
□ New Pump Station
■ Existing Pump Station
--- New Gravity Sewer
— Existing Gravity Sewer
∘∘∘∘ New Force Main
•••• Existing Force Main
SOURCE :
sheaffer & roland, inc.

Henderson Pump Station

Construction 1,413,600 $(\frac{3.74}{6.10})$	866,700
Contingencies (25%)	216,675
Salvage Value (Assume 50% of item 50-year life 50% of item 20-year life) (.6)(.5) 1,083,375 (.2645)	-(85,966)
O&M 4,600 x 10.6976	498,500
Engineering & Construction Inspection	108,300
Administration & Overhead 4,600 (10.6926)	49,200
	1,653,409
or	1,653,000

Henderson 27" Force Main 5,800 LF

Construction 3,013,100 $\frac{3.74}{6.10}$	1,847,376
Contingencies (25%)	461,844
Salvage Value (.6) 2,309,220 (.2645)	-(366,473)
O&M 8,200 (10.6976)	87,700
Engineering 230,900	230,900
Administration & Overhead 9,900 (10,6976)	105,800
	2,367,147
or	2,367,000

Existing System Costs

North Washington Pump Station O&M	53,500
North Washington Force Main 1981-2000 O&M 300 x 10.6976	3,200
	56,700
or	57,000
TOTAL	5,095,000

Costs for Northglenn Multiple-Purpose Project

Discussion

The costs for the Northglenn wastewater treatment, agricultural reuse project are given (6). Two items in the cost estimate need to be explained. They are the collection system costs and the land for the contingency plan costs.

Collection System Costs

Northglenn has purchased its wastewater collection system from the City of Thornton. Work is required on sewer system lines in order to sever the Northglenn collection system from the Thornton system. Additional construction is necessary for Northglenn to implement the multi-purpose project; all flows within Northglenn must be conveyed to Pump Station A so they can be pumped to the treatment facility in Weld County.

Two alternative costs were determined for the severance of the Northglenn collection, the cost of severing the system and having flows leave Northglenn at two different drainages to be conveyed to the Denver Metro wastewater treatment plant, and the cost of severing the system with all Northglenn flows being conveyed to Pump Station A. The present worth of each alternative cost consists of the cost of operation and maintenance of the entire collection system as well as the capital cost of the construction necessary to sever the systems.

The cost of the multi-purpose project collection system improvements is then determined as the cost of severance under the alternative where the flows will be conveyed to Denver Metro subtracted from the cost of severance if the flows will be conveyed to Pump Station A.

The work necessary to sever the Northglenn and Thornton collection systems shall not be eligible for EPA funding since presently a wastewater collection system exists and the construction is required due to a transfer of existing facilities between municipalities.

Costs of the Contingency Plan

EPA has required that in order for Northglenn to be given funding as an alternative technology project, the City would have to provide assurance that effluent would be put to agricultural use for the entire project life of 20 years. Northglenn has informed EPA that it has developed a contingency plan. At present, Northglenn owns 1,065 acres which could be irrigated using the Bull Canal system. This land was purchased by Northglenn when the City was obtaining water rights. The acquisition of the land was incidental to the purchase of water. It was determined by Northglenn and EPA concurs, that 1,065 acres would be sufficient to allow all of the treated wastewater from Northglenn to be applied to land. Northglenn has also obtained the right of first refusal from FRICO shareholders so that it can obtain the water rights necessary to implement the contingency plan. Northglenn has agreed to accept a grant condition which would require that they retain a commitment so that if farmers under the exchange agreement would no longer accept FRICO water, Northglenn, through land ownership, lease, or irrigation easement would be able to apply its treated wastewater to land. Under this plan, Northglenn will be able to sell existing land as long as it is replaced by a commitment to an equivalent amount of land.

For the cost effective analysis, it was decided to use the price of the land as a cost of the project. The land purchase will not be eligible for Federal construction grant funding since it is not an integral part of the treatment process and since the purchase was made before a grant was given.

NORTHGLENN MULTI-PURPOSE COSTS

Lagoons & Storage

Earthwork, structures, piping	$ 3,402,200
Asphalt liners & Roads	2,591,800
Landscaping	124,700
Site Buildings	418,500
	6,537,200
Contingencies 10%	653,720
	$ 7,190,920
Salvage Value (50-year life) $\frac{30}{50} = .6$	
P.W. (salvage value) = 7,190,920 (.6)(.2645)	-1,141,199
	6,049,721
Mechanical Equipment	1,161,300
Electrical Instrumentation, telemetry	488,000
Fencing	54,700
	1,704,000
Contingencies 10%	170,400
	1,874,400
Step 3 Engineering	403,600
Construction Management	342,900
O&M Cost 321,900 (10.6976)	3,443,600
Administration & General Overhead 38,800 (10.6976)	415,000
	12,529,221
Total (Lagoons & Storage)	12,529,000

Land (Northglenn Treatment Plant Site)

Land Cost	179,600
Salvage Value	-(86,000)
	93,600
	94,000

27" Force Main

1980 Construction & Contingencies	2,139,500
1980 - 2000 O&M 7,800 (10.6976)	83,400
Salvage Value (59-year life) (.6) (2,139,500) (.2645)	-(339,539)
Administration & General Overhead 9,160 (10.6976)	98,000
Step 3 Engineering	90,900
Construction Management	77,300
	2,646,839
	2,647,000

Pump Station A

1980 Construction & Contingencies	712,600
1981 - 2000 O&M 34,800 (10.6976)	372,300
Salvage Value 50-year life for 50% of item 20-year life for other 50%	
712,600 (.5) (.6) (.2645)	-(56,545)
Administration & Overhead 3,050 (10.6976)	32,600
Step 3 Engineering	30,300
Construction Management	25,700
	1,116,955
	1,117,000

Field Monitoring Program

1980 Construction & Contingencies	77,500
1981 O&M 35,100 (10.6976)	375,500
	453,000

Dacono Disinfection

1980 Construction & Contingencies	32,500
1981 - 2000 O&M	17,100
	49,600
	50,000

Firestone & Frederick Tailwater Control

Construction & Contingencies	163,700
Salvage Value of Land	-(7,200)
O&M (1,500) (10.6976)	16,046
	172,546
	173,000

Land for Contingency Plan

Cost of Land	221,900
Salvage Value	-(106,300)
Present Worth	115,600
	116,000

Collection System Costs

Multi-Purpose Project	
Construction	1,159,700
10% Contingencies	115,970
Salvage	
Assume 75% 50-year life 25% 20-year life	
.75 (1,275,670) (.6) (.2645)	-(151,836)
O&M 92,700 (10.6976)	991,700
Step 3 Engineering	54,200
Construction Management	46,100
Administration & General Overhead 5,460 (10.6976)	58,400
	2,274,234

Single Purpose Project

Construction	546,800
10% Contingencies	54,680
1981 - 2000 O&M 70,100 (10.6976)	749,900
Salvage	
Assume 75% 50-year life	
25% 20-year life	
Salvage Value .75 (601,500) .2645 (.6)	-(71,594)
Step 3 Engineering	26,400
Construction Management	22,400
Administration & Overhead	27,800
Engineering Design	29,600
	1,385,986

Difference - Multi-purpose/Single Purpose Collection System Costs

	2,274,234
	-1,385,986
	888,248
	888,000

Northglenn - Total Cost	18,067,000

*In accordance with EPA regulations the value of land was appreciated at the compound rate of 3% annually.

SUM OF THE COSTS RULE

In order for EPA to participate in the funding of a multiple-purpose project, it must be shown that the cost of the multiple-purpose project must not exceed the sum of the costs of the most cost-effective single purpose options which accomplish the same purposes.

Sheaffer and Roland has developed costs for a single purpose agricultural water supply project which would deliver water from the South Platte River to a storage reservoir located at the proposed Northglenn wastewater treatment plant site. The project would require the construction of a Platte River diversion structure, a pump station and force main to the reservoir site and a 4,000 acre-foot storage reservoir.

The following present worth cost developed for this alternative:

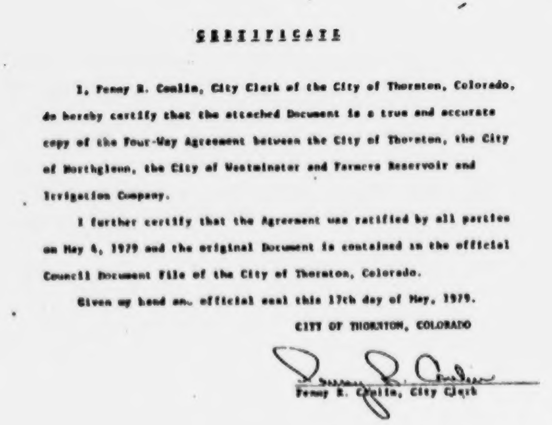
Capital Costs	11,532,900
Pipeline and storage reservoir salvage value	
Assume 50 year life	-(1,401,900)
Land salvage value	-(47.900)
Operation and Maintenance	1,246,300
	11,329,400

This cost is then added to the costs of the single-purpose wastewater treatment project.

Agricultural water supply	11,327,400
Treatment at Denver Metro	5,095,000
Conveyance to Denver Metro	5,343,000
	21,765,400

This cost is greater than the present-worth cost of the proposed Northglenn multi-purpose project, $18,067,000. Therefore, the Northglenn project complies with the sum of the cost rule.

D-1



CERTIFICATE

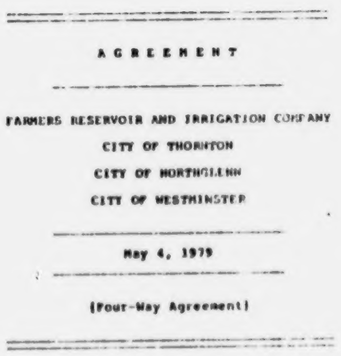
I, Penny R. Conlin, City Clerk of the City of Thornton, Colorado, do hereby certify that the attached Document is a true and accurate copy of the Four-Way Agreement between the City of Thornton, the City of Northglenn, the City of Westminster and Farmers Reservoir and Irrigation Company.

I further certify that the Agreement was ratified by all parties on May 4, 1979 and the original Document is contained in the official Council Document File of the City of Thornton, Colorado.

Given my hand and official seal this 17th day of May, 1979.

CITY OF THORNTON, COLORADO

Penny R. Conlin, City Clerk



AGREEMENT

FARMERS RESERVOIR AND IRRIGATION COMPANY
CITY OF THORNTON
CITY OF NORTHGLENN
CITY OF WESTMINSTER

May 4, 1979

(Four-Way Agreement)

AGREEMENT

THIS AGREEMENT made and entered into this 4th day of May, 1979, by and between the FARMERS RESERVOIR AND IRRIGATION COMPANY, hereinafter referred to as "FRICO", the CITY OF THORNTON, a municipal corporation of the State of Colorado, acting by and through its Utilities Board, and City Council, hereinafter referred to as "Thornton", the CITY OF NORTHGLENN, a municipal corporation of the State of Colorado hereinafter referred to as "Northglenn", and the CITY OF WESTMINSTER, a municipal corporation of the State of Colorado hereinafter referred to as "Westminster",

WITNESSETH:

WHEREAS, Thornton has previously instituted proceedings in eminent domain being Civil Action No. 43042 in the District Court in and for Jefferson County, State of Colorado, against FRICO and certain named shareholders whose shares are allocated for water delivery purposes to the Standley Lake Division of FRICO. These said shareholders, excluding Thornton, Westminster and Northglenn who ratify this Agreement are hereinafter called "Shareholders", and

WHEREAS, FRICO owns and controls land, water decrees evidencing certain appropriations of water commonly known as water rights, and certain facilities used for the diversion, storage, and distribution of certain waters located in the Clear Creek Drainage Basin, State of Colorado and included among those facilities and water rights are those referred to as Standley Lake Reservoir, the Croke Canal, and certain water rights associated therewith, and

WHEREAS, FRICO and Westminster have previously entered into agreement dated January 24, 1963, as amended, pertaining to the use and storage of certain waters in Standley Reservoir, and for the operation of the same, and

WHEREAS, FRICO and Northglenn have entered into a certain agreement dated September 2, 1976, for the first use of certain water as owned by certain stockholders and controlled by FRICO in order to supply water to Northglenn and to supply stockholders of FRICO within the Standley Lake Division with certain replacement water, and

WHEREAS, Thornton, Westminster and Northglenn own or control certain water rights; and water diversion, storage, treatment, and distribution facilities located within the South Platte, Clear Creek, and Dry Creek Drainage Basins for the purpose of furnishing a potable water supply to the present and anticipated future customers and water users from said cities, and

WHEREAS, Westminster has instituted eminent domain proceedings against FRICO and certain Shareholders being Civil Action No. 43056 in the District Court in and for Jefferson County, State of Colorado, and

WHEREAS, FRICO and certain of its Shareholders have vigorously resisted said eminent domain proceedings as instituted by Thornton and Westminster, and

WHEREAS, the parties desire to reach a settlement rendering it unnecessary to proceed with said eminent domain proceedings, and

WHEREAS, Northglenn and FRICO have entered into agreements for the sale and purchase of certain water rights which agreements are the subject of lawsuits filed by Westminster, Thornton and The Mandalay Irrigation Company being Civil Action No. 78-CV-1187 and Civil Action No. 78-CV-1188 in and for the District Court of Jefferson County, State of Colorado, and

WHEREAS, Westminster has filed suit against FRICO in Civil Action No. 78-CV-1643 in and for the District Court of Jefferson County, seeking to enjoin FRICO from objecting to

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the storage of certain Farmers High Line Canal Water in Standley Lake, and

WHEREAS, FRICO has storage available in Standley Lake Reservoir which could be made available to Thornton, and Thornton is in immediate need of reservoir storage capacity for its Clear Creek system, and

WHEREAS, FRICO has determined that by lining of the Bull Canal and laterals thereto, it will still be able to deliver to its stockholders the quantities of water they have historically enjoyed and that the ditch lining is made possible by the monies to be received from Thornton pursuant to the conveyance of ten thousand (10,000) acre-feet of storage capacity in Standley Lake Reservoir to Thornton; and

WHEREAS, Westminster has filed applications for transfer and change of water rights and exchange in cases W-8743 and W-8744, Water Division No. 1 and certain parties hereto have filed statements of opposition to those applications; and

WHEREAS, the parties to this Agreement have determined that it is in their mutual interest to enter into an agreement whereby each of the parties needs may be accommodated and satisfied in the spirit of compromise and settlement without the necessity of continuing legal proceedings and have entered into a cooperative arrangement whereby all parties obtain certain beneficial results and to enter into an era of cooperation between the municipal and certain agricultural interests in the Clear Creek and Dry Creek Drainage Basins;

NOW, THEREFORE, for and in consideration of the premises, and the following covenants, terms and conditions, and in full settlement and satisfaction of those certain eminent domain proceedings instituted by Thornton and Westminster against FRICO and certain Standley Division shareholders, parties defendant, being Civil Action No. 43043 and Civil Action No. 43056 in the District Court in and for Jefferson County, State of Colorado which compromise constitutes an involuntary conversion of the property of FRICO within the provisions of 26 U.S.C., § 1033, the Internal Revenue Code of 1954, as amended, and in full consideration of certain other conditions as hereinafter set forth, it is hereby agreed by and between the parties as follows:

1. FRICO, on its own behalf and on behalf of its stockholders, and Westminster, Northglenn, and each shareholder ratifying this Agreement, do hereby convey, quit claim, and remise to the City of Thornton, all of each party's right, title and interest in and to ten thousand (10,000) acre-feet of storage capacity in Standley Lake Reservoir situate in Jefferson County, Colorado, reserving to FRICO and its shareholders, twenty thousand (20,000) acre-feet of storage capacity in Standley Lake Reservoir from the thirty thousand (30,000) acre-feet of storage capacity in Standley Lake Reservoir, all as provided in that certain Agreement between FRICO and the City of Westminster dated January 24, 1963, as amended.

Of the ten thousand (10,000) acre-feet of storage capacity in Standley Lake Reservoir conveyed by this Agreement to Thornton, Thornton shall be entitled to the possession of five thousand (5,000) acre-feet of storage capacity on June 15, 1979, and shall be entitled to possession of the remaining five thousand (5,000) acre-feet of storage capacity in Standley Lake Reservoir one (1) year from the date of this Agreement.

2. FRICO and its shareholders further do hereby ratify and confirm, convey and quit claim the right, title and interest to the City of Westminster in and to the twelve

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thousand (12,000) acre-feet of storage capacity at Standley Lake Reservoir that Westminster obtained from the forty-two thousand (42,000) acre-feet of total storage capacity as constructed at Standley Lake Reservoir pursuant to the Agreement between FRICO and the City of Westminster dated January 24, 1963, as amended.

3. Thornton shall pay to FRICO the sum of Thirteen Million Dollars ($13,000,000), payable as follows:

a. Upon the effective date of this Agreement, Thornton shall pay the sum of Three Million Dollars ($3,000,000), which amount shall be used by FRICO to concrete line the Bull Canal Numbers I, II, and III, and all laterals from the head works of the Bull Canal on Dry Creek until their termination.

b. The unpaid balance shall be paid on a declining payment schedule of one-tenth (1/10th) of the unpaid principal, plus accrued interest, at six percent (6%) interest, per annum on the unpaid balance on January 5 of each subsequent year to this Agreement for a period of ten (10) years beginning January 5, 1980.

c. Thornton agrees to pledge the full faith and credit of the City of Thornton by ordinance duly adopted for the performance of its obligations and payment of the amounts provided in this Agreement to FRICO.

4. Westminster and Thornton agree tp Northglenn's right of first use of certain water stored in Standley Lake Reservoir, excluding the pro-rata share of water as represented by shares of Standley Lake Division stock presently owned or hereafter acquired by Westminster and Thornton as provided in Paragraph 5.a. hereof, subject to agreements between Northglenn and individual stockholders of FRICO and which are referred to and a part of that certain Agreement between FRICO and Northglenn dated September 2, 1976.

5. Regarding the twenty thousand (20,000) acre-feet of storage capacity at Standley Lake Reservoir reserved to FRICO, the following shall apply:

a. Westminster, Thornton and Northglenn, as shareholders of FRICO, whose stock is allocated for water delivery purposes to the Standley Lake Division of FRICO, shall each have the independent, free and unrestricted use of its pro-rata shareholder interest in the twenty thousand (20,000) acre-feet of storage capacity in Standley Lake Reservoir reserved to FRICO and each party's pro-rata yield from water diverted upon the decrees of FRICO in the Standley Lake Division as delivered into Standley Lake Reservoir. The pro-rata share of each city's interest in the yield from the FRICO water rights and each city's pro-rata share of FRICO's twenty thousand (20,000) acre-feet of storage capacity in Standley Lake Reservoir shall be determined by dividing the number of shares held by each city, from time to time, as allocated for water delivery purposes to the Standley Lake Division of FRICO, by two thousand three hundred seventy-three (2,373) shares.

> EXAMPLE: If the City of Thornton owns on the date of this Agreement, two hundred thirty-seven (237) shares of stock allocated for water delivery purposes to the Standley Lake Division of FRICO, the City of Thornton is entitled to the independent, free and unrestricted use of two thousand (2,000) acre-feet of storage capacity in Standley Lake Reservoir from the twenty thousand (20,000) acre-feet of storage capacity allocated to FRICO and ten percent (10%) of the yield of the water

rights of FRICO in the Standley Lake Division as such water right is available at the inlets to Standley Lake. Each other city would similarly be entitled to its pro-rata share of yield and storage capacity pursuant to the same allocation formula as set forth for the City of Thornton.

Thereafter, for example, if the City of Thornton should acquire an additional two hundred thirty-seven (237), ten percent (10%), of the shares of stock allocated for water delivery purposes to the Standley Lake Division, such additional amount, together with the previous ten percent (10%) ownership would entitle Thornton to the independent use of four thousand (4,000) acre-feet of the storage capacity reserved to FRICO and twenty percent (20%) of the yield of the water derived from the decrees of FRICO in the Standley Lake Division.

b. The decrees of FRICO shall continue to be operated and managed by FRICO for the benefit of all of its shareholders, including Westminster, Thornton, and Northglenn, with FRICO's remaining storage capacity and yield relating thereto, exclusive of the capacity and yield described in Paragraph 5(a), to be operated by FRICO for the sole benefit of its remaining shareholders who take delivery of water below the outlet works of Standley Lake Reservoir.

c. Each of the cities shall remain responsible for and agrees to pay the assessments upon FRICO stock owned

by each city as may hereafter be established as provided by law and the Articles of Incorporation of FRICO, notwithstanding the independent use of the pro-rata yield from the water rights of FRICO and the independent use of storage capacity at Standley Lake Reservoir.

d. Westminster, Thornton, and Northglenn, as shareholders, do hereby waive any entitlement to the benefits of FRICO arising under the Agreement between FRICO and Northglenn, dated September 2, 1976.

6. Each of the parties to this Agreement shall be entitled to use the unused storage space of the other parties' storage capacity in Standley Lake Reservoir on an equal share "as available" basis. The right to use storage space in Standley Lake Reservoir as provided in this Agreement shall not be separately assigned by any of the parties to, or for the benefit of, any other person, firm, or organization not a party to this Agreement without the written consent of each of the parties of Thornton, Westminster, Northglenn, and FRICO.

7. FRICO shall remain the operator and manager of the Croke Canal and the decrees of FRICO, and the pro-rata share of the twenty thousand (20,000) acre-feet of storage capacity at Standley Lake Reservoir not otherwise allocated to Thornton, Westminster or Northglenn, upon the following terms and conditions:

a. The Cities of Thornton, Westminster, and Northglenn agree to equally contribute to and pay for all expenses of operation and maintenance and all capital improvements of whatever nature necessary or appropriate for the operation of Standley Lake Reservoir to a storage capacity of forty-two thouand (42,000) acre feet, as hereinafter set forth. This obligation shall not apply in case of total dam failure.

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b. Standley Lake Reservoir shall not be operated by allocating storage capacity by "layers" and if the storage of water in Standley Lake Reservoir is restricted to a capacity less than forty-two thousand (42,000) acre-feet by any lawful order or otherwise, each of the parties to this Agreement shall have its allocated storage space at Standley Lake Reservoir proportionately reduced.

c. If there occurs a restriction of the storage capacity at Standley Lake Reservoir to less than forty-two thousand (42,000) acre-feet of storage capacity by a lawful order or otherwise, the cities shall have one hundred twenty (120) days in which to provide for a plan or program which, when completed, would restore storage capacity at Standley Lake Reservoir to forty-two thousand (42,000) acre-feet. If the cities shall not, within one hundred twenty (120) days, provide for a plan or program to restore Standley Lake Reservoir to a storage capacity of forty-two thousand (42,000) acre-feet, FRICO shall have the right to submit a plan or program for the restoration of the storage capacity at Standley Lake Reservoir to forty-two thousand (42,000) acre-feet and shall have the right, at its own expense, to provide for the completion of such plan or program to restore the storage capacity of Standley Lake Reservoir to forty-two thousand (42,000) acre-feet. If FRICO shall expend its own funds for the reduction or elimination of any storage hold order as provided in this paragraph, FRICO shall be entitled to the use of the storage capacity restored to Standley Lake Reservoir for the benefit of its shareholders, taking delivery of water below the outlet works of Standley Lake Reservoir until all amounts expended by FRICO shall have been repaid by Thornton, Westminster, or Northglenn, together with interest at the rate of nine percent (9%) per annum upon the amounts expended from the

date paid until such amounts are repaid to FRICO, at which time storage reverts back to each party in their respective allocated amounts.

8. Thornton, Westminster, and Northglenn shall each be entitled to separately operate and provide for delivery of its water stored in each party's independent storage capacity at Standley Lake Reservoir; provided, however, that the withdrawal of water by any party shall not interfere with the withdrawal of water by the other parties at Standley Lake, and further provided that the right of FRICO for the use of the outlet works at Standley Lake shall have first priority of use, all as set forth in that certain Agreement between FRICO and Westminster dated the 23rd day of September, 1974, and the rights of the City of Westminster to the use of the outlet works at Standley Lake Reservoir shall have the next priority of use to that of FRICO.

9. If Thornton, Westminster, or Northglenn shall independently provide for the delivery of its water from Standley Lake, such deliveries shall be made only through acceptable meters and measurement devices and daily records of such deliveries shall be submitted to FRICO.

On a weekly basis, FRICO shall send a report to each of the parties hereto on operations at Standley Lake, including water delivered to Standley Lake, percent of allocation of seepage or evaporation losses from water stored in Standley Lake by each of the parties and all other matters of operation and maintenance at Standley Lake as shall be necessary or appropriate.

10. Each of the parties agrees to share a proportionate loss for seepage and evaporation of water held in Standley Lake Reservoir according to a formula to be agreed upon and which shall be computed on a monthly basis, based upon the monthly average of water stored by each.

11. FRICO, as operator of the Croke Canal and the twenty thousand (20,000) acre-feet of storage space at Standley Lake Reservoir, shall submit for approval a proposed program of costs to be expended for operation, maintenance and for all matters necessary or appropriate for the operation of the Croke Canal and Standley Lake to Westminster, Thornton, and Northglenn.

If no objection to the schedule of operation and maintenance expenses shall be made within thirty (30) days, such program for operation and maintenance shall be deemed to be approved and the cities shall reimburse FRICO for its expenses incurred pursuant to the program for operation and maintenance within thirty (30) days from the date of receipt of a statement for amounts due to FRICO.

In no event shall FRICO be prevented from undertaking any action deemed necessary by FRICO to prevent or correct any emergency matter arising in the operation of the Croke Canal or Standley Lake Reservoir and all such amounts reasonably expended by FRICO to correct any emergency matter arising from the operation and maintenance of the Croke Canal and Standley Lake Reservoir shall be repaid by the Cities of Thornton, Westminster, and Northglenn to FRICO within thirty (30) days from the date of the receipt of a statement for costs expended by FRICO.

12. If Standley Lake Reservoir shall be enlarged to a storage capacity in excess of forty-two thousand (42,000) acre-feet and if the costs for such enlargement, in whole or in part, shall be provided by grant or funds provided by any non-party governmental agency or other organization, each of the parties to this Agreement shall share equally in such additional capacity available at Standley Lake.

If the capacity at Standley Lake Reservoir shall be enlarged in excess of forty-two thousand (42,000) acre-feet, and if such enlargement shall not be paid for by grant or other source of funds other than those funds paid by the parties to this Agreement; then in that event, the percent of storage capacity in excess of forty-two thousand (42,000) acre-feet shall be shared on a pro-rata basis to the amount of contribution, and each party shall have the right to contribute equally to such enlargement.

If any party to this Agreement shall not participate in the enlargement of Standley Lake Reservoir to a capacity in excess of forty-two thousand (42,000) acre-feet, the participating parties equally shall hold harmless and indemnify the party not desiring to participate in the enlargement from any loss of existing storage capacity or from any damages or liability of whatever nature arising from the enlargement of capacity of Standley Lake Reservoir in excess of forty-two thousand (42,000) acre-feet.

13. In addition to water from any other lawful source, Thornton and Westminster shall have the right to deliver water from the Church Ditch into Standley Lake Reservoir.

14. Thornton shall have access to Standley Lake for the delivery of water from the Farmers High Line Canal through the existing delivery headgate of the City of Westminster into Standley Lake from the High Line Canal as may hereafter be agreed between Thornton and Westminster, and if Thornton and Westminster shall not be able to reach an agreement for the use or reconstruction of the existing headgate and diversion structure, then Thornton shall have the right of access across lands owned by FRICO from the Farmers High Line canal to Standley Lake for the purpose of construction of a headgate and diversion structure for the delivery of waters diverted through the Farmers High Line Canal into Standley Lake Reservoir.

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15. FRICO agrees that all reuse water of a quality acceptable to FRICO for agricultural purposes being returned to FRICO Standley Lake shareholders pursuant to its reuse agreement with Northglenn will continue to be used inter alia for distribution for agricultural purposes pursuant to the Articles of Incorporation of FRICO for a minimum of twenty-one (21) years from the date hereof.

16. FRICO agrees to the transferability of any shares of stock of the Standley Lake Division previously purchased or which may be purchased by Thornton, Westminster or Northglenn free from any penalty upon the delivery of water at Standley Lake Reservoir as repraented by the shares purchased by said cities.

17. The parties hereto further agree to the following operating principles:

a. FRICO will continue to be responsible for and furnish all personnel necessary for all normal operation and maintenance requirements as to Standley Lake Reservoir, such as burning and clearing of weeds, reading and operating quages and valves, headgate and diversion structure operations, maintenance of FRICO owned property including caretaker houses, and normal preventive maintenance.

b. An Operation and Maintenance Committee shall be formed consisting of one (1) voting member from each of the cities, parties hereto, plus an ex-officio non-voting member from FRICO. An operation and maintenance expense budget for Standley Lake Reservoir and for deliveries under FRICO decrees shall be submitted annually to the Committee for its approval. FRICO shall consult freely with the Operations Committee and shall keep the Committee fully advised of the status of present and prospective criteria. The Committee shall meet monthly at a time set by the Committee or at other times as set by them by written notice

to the members from the secretary as elected by the Committee. Notice shall be considered adequate when deposited in the mails of the United States Postal Service addressed to the city managers of each respetie city and to FRICO, or whomever may be designated by each respective entity to receive said notice.

c. Operation and maintenance expenses shall be defined as all expenditures necessary to arrive at, and maintain, the Croke Canal at the existing carrying capacity and Standley Lake Reservoir capable of safely and adequately storing up to forty-two thousand (42,000) acre-feet of water.

d. Capital expenditures are defined as those expenses expended to obtain the enlargement of the Croke Canal over and above the existing carrying capacity to be determined and any enlargement of Standley Reservoir to obtain storage capacity in excess of its present constructed capacity of forty-two thousand (42,000) acre-feet or the construction of any new water delivery outlet structure.

In order to implement a capital expenditure, there shall be a preliminary investigation undertaken by a consultant to be approved by a majority of the Committee. Each party hereto has to elect to participate in the costs of the study or failure to participate in the preliminary investigation waives any right to participate further. After the preliminary investigation, the remaining parties shall agree on a consultant to do a preliminary design and shall equally contribute to the cost thereof. Failure to participate in the preliminary design waives any right to participate further. Upon completion of the preliminary design, each remaining party shall have four (4) months within which to review said preliminary design and decide whether to proceed to completion of said project. The remaining parties share the benefits of the project in proportion to the financial contribution of each. Any of the committee members can decide to start implementation of a capital expenditure; however, each party hereto shall have the opportunity to financially participate in such enlargement up to an equal percentage by each party. If any party decides to participate, it shall be entitled to its pro-rata amount of the enlarged capacity of Standley Lake Reservoir or of the Croke Canal.

e. Westminster, Thornton and Northglenn, and not FRICO, shall each be liable for and shall pay one-third (1/3) of the operation and maintenance expenses as defined in "c" above, with regard to only the Croke Canal, Standley Reservoir and appurtenant facilities thereto, but not as to any facilities below the outlet works of Standley Lake Reservoir which remain the responsibility of FRICO.

f. Nothing in this Agreement shall preclude any of the parties from instituting legal proceedings to compel performance hereunder or to require or prohibit expenditures of money for operation and maintenance if the Operations Committee has been unable to agree. The venue for any such legal dispute shall be the District Court in and for the County of Jefferson, State of Colorado.

g. Delivery of water to Northglenn pursuant to its September 2, 1976 Agreement with FRICO shall be made through FRICO's entitlement to the use of the outlet capacity from Standley Lake Reservoir, so long as Northglenn and Thornton shall not interfere with the rights preserved to FRICO and Westminster pursuant to that Agreement of September 23, 1974. Any plans by Northglenn or Thornton to attach to the outlet works shall be first submitted to FRICO and Westminster for their approval which approval shall not be unreasonably withheld.

h. Should any city which is a party hereto install any telemetering or other similar device to effectuate the delivery of water to which it is entitled, the operation of any such device shall be coordinated with FRICO and the Committee hereunder.

18. Thornton and Westminster agree to move to withdraw the Complaints and to move to dismiss with prejudice those previously-instituted legal proceedings in Civil Action No. 78-CV-1187 and Civil Action No. 78-CV-1188 in the District Court in and for Jefferson County on behalf of themselves and The Mandalay Irrigation Company in consideration for three hundred twenty-five (325) acre-feet of storage in Standley Lake Reservoir, deducted from Northglenn's pro-rata ownership and allocated to Westminster to become a part of its storage space pursuant to the terms of Paragraph 5(a).

19. Westminster shall dismiss its previously instituted proceeding in eminent domain being Civil Action No. 43056 in the District Court of Jefferson County, State of Colorado.

20. Thornton will dismiss Civil Action No. 43043 in eminent domain as against FRICO and each individual shareholder that ratifies this Agreement.

21. Westminster, FRICO and its Shareholders do agree to cancel and do hereby cancel all provisions of that specific Agreement dated January 24, 1963, as of the effective date of this Agreement.

22. Westminster and Thornton will not contest the validity of that Agreement between FRICO and Northglenn dated September 2, 1976.

23. Northglenn will recognize the ownership of the annual right to purchase Church Ditch water pursuant to the inches of water owned or to be acquired by Thornton or Westminster upon the following basis:

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a. For ownership of inches represented by a claim of title supported by abstract or title insurance, the annual right to purchase water shall be confirmed subject to the reasonable rules of Northglenn as operator relating to the carriage of water.

b. For ownership of inches represented by a claim of title not supported by abstract or title insurance, the annual right to purchase water shall be confirmed subject to the reasonable rules of Northglenn relating to the carriage of water and the execution of an agreement to save and hold Northglenn harmless for delivery of said water..

c. Delivery of water to Westminster, Thornton or Mandalay may, at their discretion, be made at the Ketner Flume.

24. This Agreement shall be enforceable by specific performance instituted by any party, against any other party or individual, it being specifically understood that the intent to enter into this Agreement is for each particular party to perform pursuant to the terms hereof, that a breach thereof and any damages resulting therefrom in not and shall not cause a termination of any of the obligations under this Agreement. The venue for any dispute hereunder is to be the District Court in and for the County of Jefferson, State of Colorado.

25. FRICO hereby agrees that it will use its best efforts to work out an agreement with the Cities of Westminster and Thornton to implement a re-use plan upon similar terms and conditions as that agreement entered between FRICO, its shareholders and Northglenn.

26. This Agreement is binding upon the parties hereto upon execution, and shall become effective upon approval at a meeting of the stockholders of FRICO to approve this

Agreement by at least sixty-seven percent (67%) of the total outstanding shares of the Standley Division and a majority of the total outstanding shares of the Barr, Milton and Marshall Divisions of FRICO. If approval of the stockholders is not obtained within six (6) months from the date hereof, this Agreement shall be null and void.

27. This Agreement shall be placed of record in the office of the Clerk and Recorder of Adams and Jefferson Counties.

28. The parties hereto have entered into stipulations attached hereto as Exhibit "A" and "B", incorporated herein by this reference, specifically as to Cases W-8743 and W-8744, Water Division 1.

29. Thornton, Northglenn, and Westminster shall be entitled to take delivery of any water they now or hereafter own or control through the Croke Canal for delivery into Standley Lake Reservoir, if at any time there shall be capacity in said canal not being utilized by FRICO. Any such unused capacity as may exist from time to time shall be shared equally by Thornton, Northglenn, and Westminster if the occasion warrants. The use by Thornton, Northglenn, and Westminster of any unused capacity shall be coordinated with FRICO as operator of said canal so as to not interfere with FRICO's ability to deliver its water.

30. The parties hereto pledge their cooperation and shall vigorously defend any action of any kind attacking the validity of this Agreement and any terms and conditions herein contained, each to pay its own costs.

This Agreement, its terms and conditions, shall be binding upon and inure to the benefit of the heirs, executors, successors and assigns of the parties hereto.

Dated this 4th day of May, 1979.

FARMERS RESERVOIR AND
IRRIGATION COMPANY (FRICO)

By Adolph Bohlender
President

ATTEST:

Secretary

APPROVED AS TO FORM:

Special Counsel

ATTEST:

Clerk

CITY OF THORNTON

Mayor, City of Thornton

ATTEST:

Clerk

Chairman, Utilities Board

APPROVED AS TO FORM:

Director of Utilities,
City of Thornton

Utilities Attorney

City Attorney

ATTEST:

Michele Gallegos
Clerk

CITY OF WESTMINSTER

Mayor, City of Westminster

APPROVED AS TO FORM:

William Christopher
City Manager,
City of Westminster

John T. Carlson
Special Counsel

City Attorney

ATTEST:

Clerk

CITY OF NORTHGLENN

Alvin B. Thomas
Mayor, City of Northglenn

APPROVED AS TO FORM:

City Manager,
City of Northglenn

City Attorney

Special Counsel

WITNESSED BY:

Richard D. Lamm,
Governor of the State of Colorado

ADDENDUM
TO
AGREEMENT

FARMERS RESERVOIR AND IRRIGATION COMPANY
CITY OF THORNTON
CITY OF NORTHGLENN
CITY OF WESTMINSTER

May 4, 1979

[Addendum to Four-Way Agreement]

ADDENDUM TO AGREEMENT

THIS AGREEMENT made and entered into this 4th day of May, 1979, by and between the FARMERS RESERVOIR AND IRRIGATION COMPANY, hereinafter referred to as "FRICO", the CITY OF THORNTON, a municipal corporation of the State of Colorado, acting by and through its Utilities Board, and City Council, hereinafter referred to as "Thornton", the CITY OF NORTHGLENN, a municipal corporation of the State of Colorado, hereinafter referred to as "Northglenn", and the CITY OF WESTMINSTER, a municipal corporation of the State of Colorado, hereinafter referred to as "Westminster",

WITNESSETH:

WHEREAS, Thornton and Northglenn have previously approved the Agreement commonly referred to as the "Four-Way Agreement" on April 17 and 19, 1979, respectively, and

WHEREAS, FRICO and Westminster have approved the commonly referred to "Four-Way Agreement", and

WHEREAS, since the approval of the Four-Way Agreement by Thornton and Northglenn, several additional items have been negotiated among the parties and to which the parties feel should be reflected in the Four-Way Agreement originally approved by Thornton and Northglenn;

NOW, THEREFORE, for and in consideration of the premises, and the following covenants, terms and conditions, and in full consideration of certain other conditions as hereinafter set forth, it is hereby agreed by and between the parties as follows:

A. Paragraph 6 of the Four-Way Agreement is hereby amended by the addition of the following sentence which is to be added thereto at the end of said paragraph, and which language is as follows:

"Initial use of such unused storage space as referred to above, shall not preclude the opportunity of others to later also share equally in the use of such space."

B. Paragraph 7(b) of said Four-Way Agreement is hereby amended in toto to read as follows:

"Standley Lake Reservoir shall not be operated by allocating storage capacity by 'layers' and if the storage of water in Standley Lake Reservoir is restricted to a capacity less than forty-two thousand (42,000) acre-feet by any lawful order or otherwise, each of the parties to this agreement shall have its allocated storage space at Standley Lake Reservoir owned by it, proportionately reduced, which is as follows:

FRICO	20/42nds (each city similarly shares a reduction by virtue of its shareholder status in FRICO).
Westminster	12/42nds.
Thornton	10/42nds.

C. Paragraph 17(b) of the Four-Way Agreement is hereby amended by the addition of a sentence to be added to the end of said paragraph which is as follows:

"All actions by the Committee shall be unanimous."

This Addendum Agreement, its terms and conditions, shall be binding upon and inure to the benefit of the successors and assigns of the parties hereto.

Dated this 4th day of May, 1979.

FARMERS RESERVOIR AND
IRRIGATION COMPANY (FRICO)

By Adolph Bohlender
President

ATTEST:
Secretary

APPROVED AS TO FORM:
Special Counsel

ATTEST:
Clerk

CITY OF THORNTON
Mayor, City of Thornton

ATTEST:
Clerk

Chairman, Utilities Board

APPROVED AS TO FORM:

Director of Utilities,
City of Thornton

Utilities Attorney

City Attorney

ATTEST:
Michele Gallegos
Clerk

CITY OF WESTMINSTER
Mayor, City of Westminster

APPROVED AS TO FORM:
William Christopher
City Manager,
City of Westminster

City Attorney

Special Counsel

ATTEST:
Clerk

CITY OF NORTHGLENN
Alvin B. Thomas
Mayor, City of Northglenn

APPROVED AS TO FORM:

City Manager,
City of Northglenn

City Attorney

Special Counsel

CERTIFICATE

I, Penny R. Conlin, City Clerk of the City of Thornton, Colorado, do hereby certify that the attached Document is a true and accurate copy of the agreement between the City of Thornton and the City of Northglenn.

I further certify that the agreement was ratified on May 4, 1979, and the original Document is contained in the official Council Document File of the City of Thornton, Colorado.

Given my hand and official seal this 17th day of May, 1979.

CITY OF THORNTON, COLORADO

Penny R Conlin
Penny R. Conlin, City Clerk

AGREEMENT

CITY OF THORNTON
CITY OF NORTHGLENN

May 4, 1979

AGREEMENT

THIS AGREEMENT, entered into this 4th day of May, 1979, by and between the CITY OF THORNTON, a municipal corporation of the State of Colorado, acting by and through its Utilities Board and City Council, hereinafter referred to as "Thornton", and the CITY OF NORTHGLENN, a municipal corporation of the State of Colorado, acting by and through its City Council, hereinafter referred to as "Northglenn",

WITNESSETH:

WHEREAS, Thornton presently owns and operates a municipal utility system consisting of certain raw water collection and storage facilities, clear water storage tanks, water treatment plants, distribution facilities and a sewage collection and transmission network designed to furnish potable water and sewer service for the present and anticipated customers of its utility system located within or without the political boundaries of Thornton, and

WHEREAS, Thornton presently provides water and sewer utility service to users residing within the present political boundaries of Northglenn, pursuant to individual contract with each user, and

WHEREAS, pursuant to § 208 of the Federal Clean Water Act, 33 U.S.C. § 1288, Northglenn has been designated a wastewater management agency by the Denver Regional Council of Governments for those areas within its political boundaries, its status being certified by the Governor of the State of Colorado to the United States Environmental Protection Agency, and

WHEREAS, Northglenn intends to establish, own and operate its own sewage collection, treatment and water distribution system, and in furtherance of that intention to

acquire from Thornton certain water and sewer utility lines located within the political boundaries of Northglenn and certain other appurtenant and related facilities located outside the political boundaries of Northglenn, and

WHEREAS, by contemporaneous agreement between Thornton, Northglenn, the Farmers Reservoir and Irrigation Company and certain individual shareholders of the Standley Division of Farmers Reservoir and Irrigation Company and the City of Westminster, Thornton is to acquire storage from FRICO in Standley Lake Reservoir and Northglenn is, by the within Agreement, to acquire all severable water and sewer utility lines, storage tanks, pumps and appurtenant facilities as described in "Exhibit A" which is attached hereto, incorporated herein, and made a part hereof, and

WHEREAS, in the future construction and operation of its own water and sewage utility system, Northglenn may construct certain facilities in which Thornton may wish to participate, and

WHEREAS, this agreement is intended to effectuate severance of certain portions of Thornton's utility system commencing upon the effective date of this agreement, and

WHEREAS, by individual contracts with users within the political boundaries of Northglenn, Thornton has commitments to serve said users into 1988, and has agreed to sever these users from the Thornton system, which will result in the loss of water and sewer income to Thornton, to which they would have been entitled, had Northglenn not decided to implement its own utility system and which source would have partially defrayed the cost of operating and maintaining the total Thornton utility system through the year 1988, and

WHEREAS, it is the intent of the parties hereto to structure the severance of certain water and sewer lines owned by Thornton by "contract termination" in such a manner

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that Thornton's utility system revenues will be maintained in as good a condition had the Northglenn users remained on the Thornton system through the period of contractual obligation, and

WHEREAS, "physical disconnection" from the Thornton utility system by the users within the political boundaries of Northglenn will create certain operational problems necessitating additional expenditures of monies by Thornton in building certain physical facilities in order to effectuate an orderly and complete severance of the Northglenn utility users from the Thornton utility system, and it is the intention of the parties hereto that Northglenn shall reimburse Thornton for said monies necessary to be expended, and

WHEREAS, the method and cost of physical disconnection and contract termination was determined on behalf of parties pursuant to a three-volume report prepared by URS Company, and

WHEREAS, it is to the mutual benefit of both Thornton and Northglenn to effectuate an agreement which will erase the burden of severance costs which might otherwise be borne by Thornton and which will resolve all present differences between the two cities in order to avoid the wasteful duplication which could result if the utility lines and appurtenances presently located within the City of Northglenn were not acquired by Northglenn, or if any physical severance were to be in strict adherence to political boundaries of the various cities, and

WHEREAS, in the spirit of municipal cooperation, it is to the mutual advantage of both parties to enter into such an appropriate agreement, as hereinafter set forth.

NOW, THEREFORE, in consideration of the above premises and the following covenants, terms and conditions, it is

3. Cost of Contract Termination. In order to provide that revenues to the Thornton utility system shall not be materially different than what would have been the case if Northglenn utility users under contract to Thornton were to remain on the Thornton utility system through April 1, 1988, Northglenn shall, at the time of partial or total physical disconnection of either water or sewer service to its residents from the Thornton utility system, commence paying on a monthly basis to the City of Thornton through March 31, 1988, certain sums of money to be computed as follows:

(a) Total Disconnection. Commencing at the date of actual total physical disconnection by Northglenn from the Thornton Utility System, Northglenn shall pay to Thornton, the sum of One Million Seven Hundred Fifty Thousand Dollars ($1,750,000) at the rate of One Hundred Forty-Five Thousand Eight Hundred Thirty-Three Dollars and Thirty-Three Cents ($145,833.33) per month, due in advance on the first day of each month, through the March 1, 1988 payment.

(b) Partial Disconnection. If Northglenn shall disconnect from the Thornton Utility System in stages, then in that event, Northglenn shall pay to Thornton twenty-five percent (25%) of the annual payment due pursuant to (a) above upon the same terms and conditions if the severed service is sewer service and seventy-five percent (75%) of the annual payment due pursuant to (a) above, upon the same terms and conditions if the severed service is water service, all in addition to the continuing payment by Northglenn to Thornton for the non-severed service, as provided elsewhere herein, until total disconnection of both services at which time the full terms and conditions of (a) above shall commence.

(c) From and after the effective date of this agreement, any rebates required under existing contracts and

Utility Extension Policy Contracts as to properties located within Northglenn shall be the obligation of Northglenn.

As to any connections made to the utility system located within Northglenn from and after effective date of this agreement, any rebates due under assigned Utility Extension Policy Contracts as to those connections shall also be the obligation of Northglenn.

4. Master Meter Contract. Commencing from the date of the execution of this Agreement, Thornton shall continue to provide treated water and sewer service to the residents of Northglenn at the same rates paid by Thornton users until actual physical disconnection occurs, which is contemplated to be November 1, 1980. If actual physical disconnection does not occur on that date, Thornton shall continue to provide the treated water and sewer service at the same rates as paid by Thornton users on an "as available basis" until November 1, 1983, giving first preference to Thornton and other utility users receiving service from its system as of the date of this Agreement and second preference for available supplies and capacity to Northglenn users.

From the date of this Agreement, Northglenn shall have the following rights, duties and responsibilities:

a. It shall have complete operational control of those utility lines located within its political boundaries as described on "Exhibit A", consistent with all rights, duties and responsibilities of the fee ownership of said utility lines which are to be acquired from Thornton as provided herein.

b. It shall assume any and all expenses for operation, maintenance, meter reading, billing, and line repair, installation or replacement for said facilities as required.

c. Northglenn shall be entitled to retain as its own and assume all rights, duties and responsibilities for any or all tap fees, system development charges or water resource fees within its incorporated limits for connections to the utility lines to be acquired from Thornton.

d. The rights, duties and responsibilities of all service contracts and Utility Extension Policy Contracts (UEPC) by which Thornton has agreed to provide water and sewer service and tap connections to the residents and users within Northglenn shall, upon the date hereof, become the property of Northglenn and Northglenn shall assume all rights, duties, responsibilities and obligations thereunder. Thornton shall transfer the originals thereof to Northglenn within thirty (30) days of the date hereof.

e. Northglenn shall negotiate all new contracts for water and sewer service within the political boundaries of Northglenn and Thornton shall provide service therefor.

f. The Master Meter for the purpose of this contract shall exist at the water meter for each tap located within Northglenn. Northglenn shall read all meters monthly and shall monthly submit to Thornton the total quantity of water measured by each water meter, as well as copies of all meter readings. Thornton will bill to Northglenn the total amount due for water and sewer services based upon the measurements made by Northglenn as confirmed by Thornton, at the rates charged to Thornton users from time to time. Northglenn shall bill for and collect all charges for water and sewer services. Sewer charges shall also be computed on the same basis as to Thornton users. Until actual physical severance occurs, Thornton retains the right to spotcheck individual meter readings.

g. Until such time as notified in writing by Northglenn, or November 1, 1980, whichever occurs first, Thornton, with its own personnel, shall continue to provide all operation and maintenance functions and shall continue to do the actual physical reading of all water and sewer meters within Northglenn and will also continue to do the billing the same as is presently the case. Northglenn shall pay to Thornton monthly in advance the sum of Twenty Thousand Dollars ($20,000) for such services commencing and pro-rated to the date of this Agreement

5. Northglenn Sewer Service to Certain Thornton Inhabitants. Northglenn shall accept, treat and dispose of sewage effluent from those certain customers in the areas of Thornton as set forth on "Exhibit B", which is attached hereto and made a part hereof, at no cost to those customers of Thornton and shall be responsible for the operation and maintenance of the appropriate trunk lines thereto as are located within the political boundaries of Northglenn. Northglenn shall be entitled to claim credit for and keep all effluent collected from this service area. Northglenn shall have no authority over nor determination of who or how many sewage taps may be connected to said trunk lines within the political boundaries of Thornton, but Thornton shall be required to pass an ordinance similar to the one set forth in "Exhibit C", attached hereto and made a part hereof by this reference, so as to prevent any discharge into the sewer lines of material that would make treatment by Northglenn unlawful or unreasonably uneconomical. Thornton shall have no objection to the right of Northglenn to the use and total consumption of this sewage effluent that

Northglenn might be able to accomplish or obtain through the appropriate Water Court of the State of Colorado and will support an application by Northglenn to the Water Court for the right to the use of said effluent in the same manner as would be allowed to Thornton.

a. Thornton will provide all necessary operation, maintenance and capital expenses associated with the sewage collection and distribution systems to be served by Northglenn, from the point of collection from the individual discharge points to the political boundaries of Thornton. In the event repair or maintenance expenditures are required by either Thornton or Northglenn to those lines located within either City necessary to meet the service requirements of the customers located within those areas set forth on "Exhibit B", either city may, at its sole election after ten (10) days' notice to the other, within which said other city must commence the work necessary to correct the problem, expend such monies as are necessary to provide proper service and bill the cost of such repairs to the other. If any capital expenditures are deemed necessary to lines within Thornton, as determined by Thornton, these shall be the sole obligation of Thornton.

b. In providing services to Thornton customers set forth on "Exhibit B", Northglenn shall indemnify Thornton against any suits brought on account of any property damage or injury of any parties resulting from such provision of service within the area set forth on "Exhibit B" and arising from acts of negligence or intentional misconduct by Northglenn, its agents, contractors or employees.

6. Thornton Sewer Service to Certain Northglenn Inhabitants. Thornton shall accept, treat and dispose of sewage effluent from those customers in the areas of Northglenn as set forth on "Exhibit D" which is attached hereto and made a part hereof, at no cost to those customers of Northglenn, and shall be responsible for the operation and maintenance of the appropriate trunk lines located within the political boundaries of Thornton. Thornton shall be entitled to claim credit for and keep all effluent collected from this service area. Thornton shall have no authority over nor determination of who or how many sewage taps may be connected to said trunk lines within the political boundaries of Northglenn but Northglenn shall be required to pass an ordinance similar to the one attached hereto as "Exhibit C" so as to prevent any discharge into the sewer lines of material that would make treatment by Thornton unlawful or unreasonably uneconomical. Northglenn shall have no objection to the right of Thornton to the use and total consumption of this sewage effluent to the extent that Thornton might be able to accomplish or obtain through the appropriate Water Court of the State of Colorado, and will support an application by Thornton to the appropriate Water Court of Colorado for the right to the use of said effluent in the same manner as would be allowed to Northglenn.

a. Northglenn will provide all necessary operation, maintenance and capital expenses associated with the sewage collection and distribution system to be served by Thornton from the point of collection from the individual discharge points to the political boundaries of Northglenn. In the event repair or maintenance expenditures are required by either Northglenn or Thornton to those lines located within

either city necessary to meet the service requirements of the customers located within those areas set forth on "Exhibit D", either city may, at its sole election, after ten (10) days' notice to the other, within which said other city must commence the work necessary to correct the problem, expend such monies as are necessary to provide proper service and will bill the cost of such repairs to the other. If any capital expenditures are deemed necessary to lines within Northglenn, as determined by Northglenn, these shall be the sole obligation of Northglenn.

b. In providing service to Northglenn customers set forth on "Exhibit D", Thornton shall indemnify Northglenn against any suits brought on account of any property damage or injury of any parties resulting from such provision of service within the area set forth on "Exhibit D" and arising from acts of negligence or intentional misconduct by Thornton, its agents, contractors or employees.

7. Indemnification. For any and all contracts relating to utility service to property and users located within the political boundaries of Northglenn identified on "Exhibit E" attached hereto and incorporated herein by this reference Northglenn, from the effective date of this agreement, shall be entitled and shall succeed to all rights, duties, and obligations, whether monetary or otherwise, and all responsibilities of Thornton pursuant to the same and Northglenn shall indemnify Thornton from and against any and all claims, suits, demands, actions, and liabilities of any nature whatsoever, including all costs and attorney's fees incurred by Thornton, which may arise by reason of any failure by Northglenn to perform, in full, the obligations assumed under said contracts, and further agrees

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to defend any action and pay any judgments against Thornton arising out of such performance or failure to perform under said contracts or Utility Extension Policy Contracts. Thornton agrees to cooperate in suits filed by or against Thornton prior to the effective date of this agreement and arising out of the contracts set forth on "Exhibit E". In particular, Northglenn is obligated to pay all rebates and honor all free prepaid taps as set forth in those contracts. Thornton shall transfer to Northglenn all previously deposited monies for all individual user service contracts. Thornton shall remain liable for all bonded indebtedness previously incurred by it, arising out of the purchase by it of that part of the Thornton system acquired by Northglenn herein and set forth in "Exhibit A". Thornton shall also remain liable for the payment of any damages as set forth on Third Claim for Relief, that may be awarded the Plaintiffs in the pending lawsuit of Rollins v. Thornton (C.A. No. 33196) in the Adams County District Court.

8. Condition of Utility Lines--Exclusion of Warranty. It is hereby agreed that the purchase of any facilities as described in "Exhibit A" by Northglenn is on an "as is" basis, there being no express or implied warranty of fitness, condition, materials or workmanship of any kind by Thornton; however, Thornton shall cooperate to the extent of furnishing drawings, diagrams and other material which it may have in its possession that relate to said facilities which may be a benefit to Northglenn in operating and maintaining such facilities. Further, until actual physical possession is relinquished to Northglenn, or until Northglenn elects to assume operation and maintenance of said lines within Northglenn, whichever occurs first, Thornton shall continue to operate and maintain said facilities in a manner consistent with reasonable standards

of the utility industry for so long as individual users within the political boundaries of Northglenn are continuing to receive utility service from Thornton.

9. Utility Status.

a. From and after the effective date hereof, Northglenn shall not seek any state or federal water or sewer management status or other utility status which would in any way involve control over or decision making authority with regard to any of the present or future customers to be served by the City of Thornton or of any areas located within the political boundaries of Thornton, as it now or may exist in the future or areas reasonably anticipated to be served by Thornton as determined by it, and except as set forth below will further limit itself to utility service and management decisions with regard to only those customers as located within the political boundaries of the City of Northglenn.

b. Except as provided in Paragraph "C" below, Northglenn agrees that it will not, after the date upon which this instrument becomes operative, directly or indirectly, sell, lease or otherwise dispose of any raw or treated water or provide sewage services for domestic or municipal use, or provide domestic or municipal water service, outside its present municipal boundaries to any person or entity for any area not currently receiving such water or water service or sewer service unless application therefor shall have first been made to Thornton, in writing, and unless:

i. Thornton finds that it is not able to provide water, water service, or sewage service for such area within a reasonable time after receipt of the application, with the result that

Thornton declines to accept, in writing, the application, or

ii. Thornton finds that it is able to provide such water, water service, or sewer service, but for other reasons declines to accept, in writing, the application.

iii. Northglenn may furnish sewage effluent to the Farmers Reservoir and Irrigation Company pursuant to that certain agreement dated September 2, 1976, and shall furnish sewage service to certain Thornton residents pursuant to the terms and conditions herein.

c. Northglenn will not interfere with Thornton's determination of wastewater services necessary for Thornton or its utility users, nor seek to exercise any wastewater management agency authority over the area within the incorporated limits of Thornton as it now or may exist in the future and as described as the Lower Thornton Service Area described in the Northglenn 201 Service Plan, except as set forth below:

1. Thornton and Northglenn may mutually agree to waive the condition set forth in this paragraph if it appears to be in the mutual best interest of both parties. The principal purpose of such waiver would be to provide protection to Thornton for its own wastewater plans in the event subsequent management agency designation is denied to Thornton.

10. Actual Physical Severance. Actual physical disconnection shall occur during a time to be agreed upon by Thornton and Northglenn; such physical severance shall not commence until Northglenn has completed its water supply and reuse storage treatment systems. If physical severance is

able to occur with regard to either the water or the sewage part of the utility system prior to simultaneous severance, the rates charged by Thornton shall reflect such partial severance, and monthly payments as to the service partially severed, shall commence immediately pursuant to Paragraph 9 hereof.

11. Raw Water Lease. From and after the date of actual physical severance of the utility systems, Northglenn may lease raw water from Thornton, and Thornton shall lease upon written request, raw water to Northglenn on an "as available" basis. The decision as to whether said raw water is actually available for lease shall be as determined by the Utilities Board of Thornton. The base rental rate for any raw water leased from Thornton to Northglenn shall be at what the Denver Water Board would lease raw water for during the same period.

12. Treated Water Service. Thornton shall be entitled to receive treated water for raw water which it may elect to deliver at its cost to the Northglenn Water Treatment Plant. The treatment costs for raw water delivered to Northglenn by Thornton shall be at the cost according to the following schedule:

a. For the period April through October, Northglenn shall treat not to exceed a maximum of three million (3,000,000) gallons per day of Thornton raw water at a rate of Seventy-Five Cents (75¢) per one thousand (1,000) gallons, with the base year equal to 1981, subject to annual adjustments by the change in the Consumer Price Index.

b. For the period November through March, Northglenn shall treat not to exceed a maximum of eight million (8,000,000) gallons per day of Thornton raw water at a rate of Sixty-Five Cents (65¢) per one

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Thornton declines to accept, in writing, the application, or

ii. Thornton finds that it is able to provide such water, water service, or sewer service, but for other reasons declines to accept, in writing, the application.

iii. Northglenn may furnish sewage effluent to the Farmers Reservoir and Irrigation Company pursuant to that certain agreement dated September 2, 1976, and shall furnish sewage service to certain Thornton residents pursuant to the terms and conditions herein.

c. Northglenn will not interfere with Thornton's determination of wastewater services necessary for Thornton or its utility users, nor seek to exercise any wastewater management agency authority over the area within the incorporated limits of Thornton as it now or may exist in the future and as described as the Lower Thornton Service Area described in the Northglenn 201 Service Plan, except as set forth below:

1. Thornton and Northglenn may mutually agree to waive the condition set forth in this paragraph if it appears to be in the mutual best interest of both parties. The principal purpose of such waiver would be to provide protection to Thornton for its own wastewater plans in the event subsequent management agency designation is denied to Thornton.

10. Actual Physical Severance. Actual physical disconnection shall occur during a time to be agreed upon by Thornton and Northglenn; such physical severance shall not commence until Northglenn has completed its water supply and reuse storage treatment systems. If physical severance is

able to occur with regard to either the water or the sewage part of the utility system prior to simultaneous severance, the rates charged by Thornton shall reflect such partial severance, and monthly payments as to the service partially severed, shall commence immediately pursuant to Paragraph 1 hereof.

11. Raw Water Lease. From and after the date of actual physical severance of the utility systems, Northglenn may lease raw water from Thornton, and Thornton shall lease upon written request, raw water to Northglenn on an "as available" basis. The decision as to whether said raw water is actually available for lease shall be as determined by the Utilities Board of Thornton. The base rental rate for any raw water leased from Thornton to Northglenn shall be at what the Denver Water Board would lease raw water for during the same period.

12. Treated Water Service. Thornton shall be entitled to receive treated water for raw water which it may elect to deliver at its cost to the Northglenn Water Treatment Plant. The treatment costs for raw water delivered to Northglenn by Thornton shall be at the cost according to the following schedule:

a. For the period April through October, Northglenn shall treat not to exceed a maximum of three million (3,000,000) gallons per day of Thornton raw water at a rate of Seventy-Five Cents (75¢) per one thousand (1,000) gallons, with the base year equal to 1981, subject to annual adjustments by the change in the Consumer Price Index.

b. For the period November through March, Northglenn shall treat not to exceed a maximum of eight million (8,000,000) gallons per day of Thornton raw water at a rate of Sixty-Five Cents (65¢) per one

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thousand (1,000) gallons, with the base year equal to 1981, subject to annual adjustments by the change in the Consumer Price Index.

It is specifically agreed by and between the parties hereto that the quantities of water set forth in Paragraph Nos. "a." and "b." above are the maximum treatment capacities available based upon present population of Northglenn. Northglenn may require the reduction of the levels of treated water capacities available to Thornton and by subsequent agreement, the parties hereto will more specifically define the amount of treatment capacity that may be available to Thornton without diminution. It is understood that Northglenn is not obligated to furnish any such treatment capacity indefinitely unless agreed to otherwise.

13. Other Services.

a. Northglenn is building a raw water supply line from Standley Lake Reservoir to its water treatment plant in which Thornton may wish to participate. Within two weeks after the effective date of this Agreement, Thornton shall notify Northglenn of the extent to which it wishes to participate in said pipeline. Thornton's participation shall be from the Standley Lake Reservoir outlet works along the line of said pipeline to a point mutually agreed upon between Northglenn and Thornton. Each city can use the unused capacity of the other at any time on an "as available" basis. The cost to Thornton for participation in the Northglenn pipeline as oversized shall be shared pro-rata based upon each city's capacity in said pipeline. Costs shall be defined as those expenditures by Northglenn for pre-design, design, monetary easement acquisition and actual construction.

b. At certain points to be agreed upon between the engineering departments of both cities, there shall be certain metered interconnections between the treated water systems of each city, the cost thereof to be jointly shared by the cities. The purpose of said interconnections is to provide for emergency service between each city's system whereby if all or a portion of a particular city's treatment and distribution system should fail for some reason, the other city would be able to provide emergency service pending the correction of the problem. Water shall be so provided at the same rates charged within the providing city.

14. Street Cut Ordinances. In order to avoid unnecessary duplication and costs associated with major street improvements and to avoid a city having to subsequently cut and dig up part of the street to install utility services, each city shall exchange street cut ordinances and the respective City Managers shall, by letter notify each other of procedures for notification of major street improvements so that the other city may have an opportunity to schedule utility installations to correspond with the street improvements.

15. Rights-of-way. Northglenn, at its expense, shall provide Thornton such rights-of-way across public lands as may be required by Thornton for the installation of lines and facilities within the boundaries of the City of Northglenn as a result of Thornton's loss of access to the water and sewer utility lines located within Northglenn. Thornton, at its expense, shall also provide Northglenn with any rights-of-way across public lands necessary for the installation of lines and facilities that are required to provide water and sewer services to Northglenn's customers.

16. Ancillary Matters. Northglenn intends to build what is commonly known as the "Bull Canal Reservoir". The reservoir could be enlarged to provide an additional capacity of approximately two thousand (2,000) acre-feet. Until March 15, 1979, Thornton shall have a first right of refusal to participate in an enlargement of the reservoir to the extent not needed by Northglenn and to pay the pro-rata cost of the construction of said reservoir enlargement. If Thornton elects to pay for the cost of construction of the additional capacity, Northglenn shall be entitled to the cost of designing and constructing said enlargement.

17. Captions. The captions for the numbered pararaphs herein are not to be used to vary the meaning of the paragraphs and are for identification purposes only.

18. Recordation. A copy of this agreement shall be placed of record in the office of the Adams County Clerk and Recorder.

19. Fire Hydrants. Until actual physical severance as referred to above occurs, fire hydrants located within the political boundaries of Northglenn shall not be used for anything other than fire fighting purposes unless the water as used therefrom is metered and if so, copies of said meter readings shall be submitted promptly to Thornton so that Northglenn shall be billed for the amount of water so used pursuant to Paragraph 4(f) hereof and in addition to the other payments herein, Northglenn shall continue to pay the monthly fire hydrant fee.

20. Water Breaks. Until actual physical severance occurs, Northglenn shall notify Thornton promptly of any and all breaks which may occur in water lines and Thornton retains the right to fix any breaks if, in their opinion, they are not being promptly attended to, and bill Northglenn for the same in order to avoid a waste of water.

a. Until actual physical severance occurs, Northglenn shall maintain all meters within its political boundaries in a good and workmanlike condition.

21. Severability. This agreement shall continue in full force and effect regardless of whether an individual paragraph may be determined to be invalid. For this purpose, each provision of the agreement shall be considered severable.

22. Purchase of Facilities. Northglenn shall purchase and Thornton shall convey the facilities described on "Exhibit A" for a purchase price of Twelve Million Five Hundred Thousand Dollars ($12,500,000), payable as follows:

a. Five Million Dollars ($5,000,000), payable on or before the expiration of ninety (90' days from execution of this agreement.

b. The balance of Seven Million Five Hundred Thousand Dollars ($7,500,000) to be paid over a ten (10) year period, commencing upon the date of the Five Million Dollars ($5,000,000) payment, said principal balance to bear interest at the rate of six percent (6%) per annum upon the unpaid balance, payable in ten (10) equal annual installments of principal and interest, of One Million, Nineteen Thousand, Twenty-Five Dollars ($1,019,025) per year from the first payment which shall be due one (1) year from the date of the Five Million Dollar ($5,000,000) down payment. Northglenn shall have the right and option of prepaying the principal indebtedness, together with interest accrued to the date of prepayment at any time without penalty. If the method of payment shall be successfully challenged by a Court of competent jurisdiction, then in that event, the total remaining unpaid balance shall be immediately due and payable; further, Northglenn shall indemnify Thornton against any and all claims and judgments which might arise out of any such successful challenge.

23. Specific Performance--Venue. This agreement shall be enforceable by specific performance instituted by any party, against any other party or individual, it being specifically understood that the intent to enter into this agreement is for each particular party to perform pursuant to the terms hereof, that a breach thereof and any damages resulting therefrom is not and shall not cause a termination of any of the obligations under this agreement. The Venue for any dispute hereunder is to be the District Court in and for the County of Adams, State of Colorado.

24. Approval. This agreement shall become binding upon approval by ordinance of the parties pledging the full faith and credit of each city to the fulfillment of the terms hereof.

THIS AGREEMENT shall be binding upon the parties hereto and their successors or assigns.

ATTEST:
Shirley Whetten
Clerk

CITY OF NORTHGLENN
Alvin B. Thomas
Mayor, City of Northglenn

APPROVED AS TO FORM:
Stanley Bender
City Manager,
City of Northglenn

Charles L. Sharp, Jr.
City Attorney

J D Musick
Special Counsel

ATTEST:
Clerk

CITY OF THORNTON
Tony C. Ritter
Mayor, City of Thornton

ATTEST:
Clerk

Chairman, Utilities Board

APPROVED AS TO FORM:
Director of Utilities,
City of Thornton

Utilities Attorney

City Attorney

WITNESSED BY:
Richard D. Lamm,
Governor of the State of Colorado

"EXHIBIT A"

All right, title, interest, duty and obligations of Thornton in and to the following:

The water and sewer utility lines, mains, right-of-ways, chooses-in-action, and any and all physical pipeline facilities, manholes, pumps, including the two million (2,000,000) gallon per day one hundred twenty-five (125) horsepower pumping station at approximately 112th and Cherokee, clean outs, traps or such other parts thereto as constitute the water and sewer utility line distribution system and easements and rights-of-way therefore as are located within the incorporated limits of the City of Northglenn and owned by and controlled by Thornton.

Also, the two (2) two million (2,000,000) gallon steel clear water storage tanks located at 112th Avenue and Cherokee within the incorporated limits of Northglenn, and a perpetual easement for the ground underlying said tanks as well as a perpetual fifteen foot (15') easement for ingress and egress, to said tanks for maintenance and repair therefore, said easement to be marked by Thornton.

Specifically excluded from the conveyance herein is the twenty-inch (20") waterline along the west side of Interstate 25 from the storage tanks at 112th Avenue and Cherokee to 104th Avenue, and the ten-inch (10") waterline running east from that point at approximately 104th Avenue and Interstate 25 to North Washington Street. Exlcuded also is the eight-inch (8") waterline along 104th from Washington to Irma Drive, as well as the twelve-inch (12") and eight-inch (8") waterlines along 120th Avenue between Interstate 25 and Sylvia Drive. Excluded also are the ten-inch (10") and sixteen-inch (16") waterlines on inlet side of Huron pump station from approximately Pelon Drive and Fred Drive to the Huron station; the twelve-inch (12") waterline running south from the Huron station (inlet side) along Huron Street to approximately 96th Avenue; ten-inch (10") waterline on the discharge side of the Huron Station from the Huron Station along Huron to approximately 96th Avenue; eight-inch (8") and six-inch (6") waterlines along Croke Drive from 96th Place to 100th Avenue; eight-inch (8") waterline along 100th from Croke Drive to Pecos Street.

Also, specifically excluded herefrom is the booster pump station located near 98th Avenue and Huron Street.

Specifically excluded therefrom is the four million (4,000,000) gallon clear water storage tank located at 112th Avenue and Cherokee within the incorporated limits of Northglenn and adjecent to the two (2) two million (2,000,000) gallon clear water storage tanks referred to above.

Also, specifically excluded therefrom is the fifteen-inch (15") and eighteen-inch (18") sewerline running north from 104th Avenue to its intersection with the twenty-seven-inch (27") sewerline east of approximately 105th Avenue and Irma Drive and the twenty-seven-inch (27") sewerline running north and east from that point to Northglenn's eastern city limits.

"EXHIBIT B"

Set forth below are the residences and areas located within Thornton to be provided sewage services by Northglenn as set forth in Paragraph 5 hereof (see attached maps which are incorporated herein):

1. Washington Square Area, which includes the entire East 1/2 Section 34, Township 1 South, Range 68 West, 6th Principal Meridian, as delineated in Figure 1, attached.

2. Parkside Area, which is described as the Northgwest 1/4 Section 16, Township 2 South, Range 68 West, 6th Principal Meridian, as delineated in Figure 2.

3. Hillcrest Area, described as a portion of the East 1/2 Section 16, Township 2 South, Range 68 West, 6th Principal Meridian, as delineated in Figure 3.

4. Woolco-Target Area described as a portion of the North 1/2 Northwest 1/4 Section 14 and the Northeast 1/4 Northeast 1/4 Section 15, Township 2 South, Range 68 West, 6th Principal Meridian, as delineated in Figure 4 and including parcel 001 of Block 03 located on page 353 of the Adams County Tax Assessors plot book.

FIGURE - 1
EXHIBIT B

WASHINGTON SQUARE AREA

THE EAST 1/2 SECTION 34, TOWNSHIP 1 SOUTH, RANGE 68 WEST, 6th PRINCIPAL MERIDIAN, AS DELINEATED BELOW.

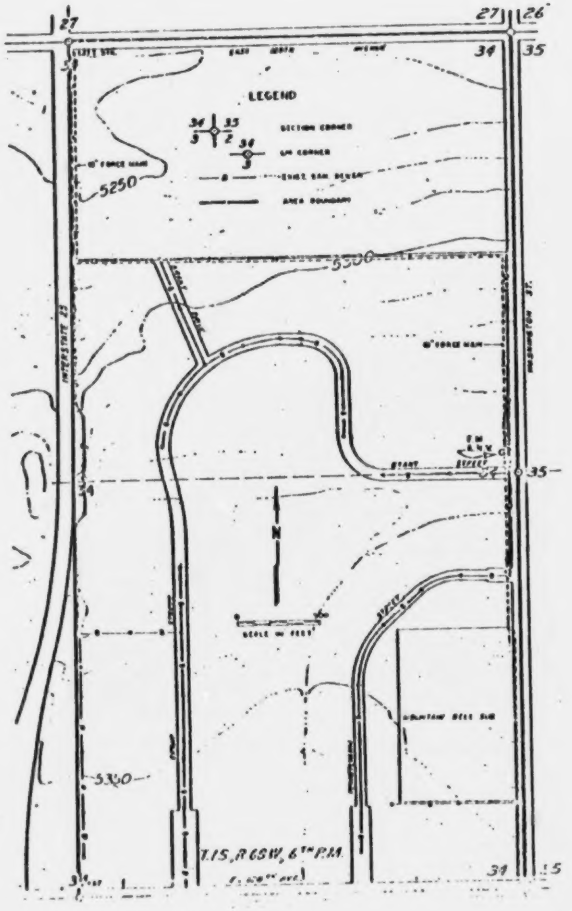

27
27
26
34
35
LEGEND
SECTION CORNER
1/4 CORNER
EXIST. SAN. SEWER
AREA BOUNDARY
5250
5300
35
34
N
SCALE IN FEET
5350
T.1S, R.68W, 6TH P.M.
34
35
INTERSTATE 25
WASHINGTON ST.

FIGURE - 2
EXHIBIT B

PARKSIDE AREA

THE NORTHWEST 1/4 SECTION 16, TOWNSHIP 2 SOUTH, RANGE 68 WEST, 6th PRINCIPAL MERIDIAN, AS DELINEATED BELOW.

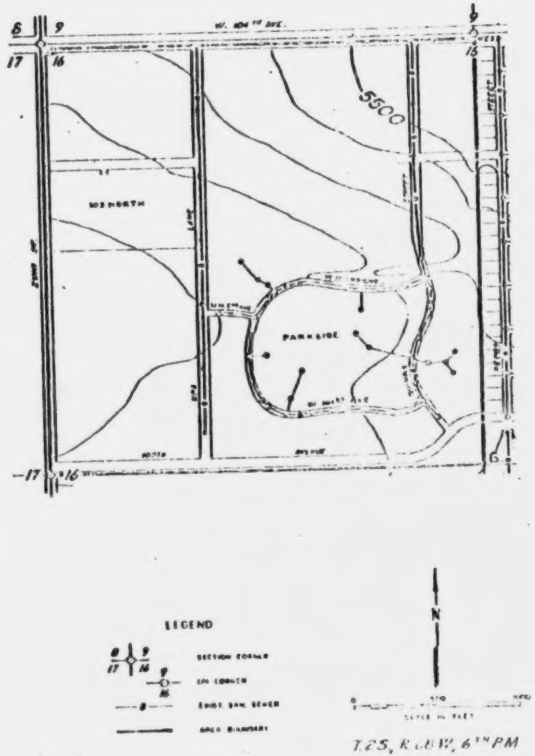
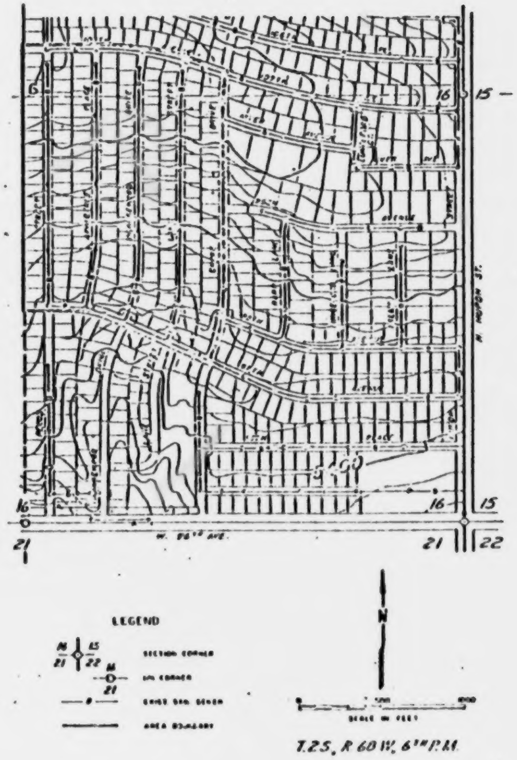

8
9
17
16
W. 104TH AVE.
9
16
5500
PARKSIDE
17
16
16
LEGEND
SECTION CORNER
1/4 CORNER
EXIST. SAN. SEWER
AREA BOUNDARY
N
SCALE IN FEET
T.2S, R.68W, 6TH PM

FIGURE-3
EXHIBIT D

HILLCREST AREA

A PORTION OF THE EAST 1/2 SECTION 16, TOWNSHIP 2 SOUTH, RANGE 68 WEST, 6th PRINCIPAL MERIDIAN, AS DELINEATED BELOW.


15
16
21
22
W. HURON ST.
W. 96TH AVE.
LEGEND
SECTION CORNER
1/4 CORNER
EXIST SAN. SEWER
AREA BOUNDARY
N
0
500
1000
SCALE IN FEET
T.2S., R 68 W., 6TH P.M.

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815262 815066 815066

SEP 10 9 47

County of Jefferson State of Co
Recorded at

17 811

AGREEMENT

THIS AGREEMENT, made and entered into this 2nd day of September, 1976, by and between The Farmers Reservoir and Irrigation Company, hereinafter referred to as FRICO, and the City of Northglenn, a municipal corporation existing under the laws of the State of Colorado, hereinafter referred to as Northglenn, Witnesseth:

WHEREAS the parties recognize that maintenance of existing rural-urban linkages is essential to sustaining a desirable quality of life in both the rural and urban sectors; and

WHEREAS the parties seek to work cooperatively in an effort to strengthen and enhance these rural-urban linkages for their mutual benefit; and

WHEREAS a majority of the shareholders of The Farmers Reservoir and Irrigation Company authorized and approved the concept of a water exchange as set forth in this Agreement by their vote at a special shareholders meeting held on August 24, 1976;

815262

2301 243

SEP 10 AM 11 12

County of Jefferson State of Co
Recorded at

NOW THEREFORE FRICO for and in consideration of the delivery to FRICO by Northglenn of that additional amount of water which totals not less than ten percent (10%) of the water delivered by FRICO to Northglenn as provided herein but not less than 500 acre-feet of water and 1500 acre-feet of storage space furnished FRICO by Northglenn during each of the years in which this Agreement is operative, FRICO, on an exchange of water basis, agrees to supply Northglenn (from Standley Lake operated and controlled by FRICO) sufficient water on an annual basis for the use of Northglenn as hereinafter provided, but, subject however, to all of the terms and provisions set forth herein below:

1. The amount of water to be exchanged annually pursuant to this Agreement shall be based upon Northglenn's dry year demand for water in light of existing and projected population figures for the City. For the purpose of illustration, the dry year demand for the present population of approximately 35,000 would require the annual diversion of 6125 acre-feet; a population of

40,000 would require 7148 acre-feet; and the maximum population projected for Northglenn of 48,000 would require the annual diversion of 7785 acre-feet. It is expressly covenanted and agreed, however, that FRICO incurs no obligation to provide water to Northglenn beyond its own physical capacity to do so. Notwithstanding any provision in this paragraph to the contrary, FRICO shall not be obligated to retain any water in Standley Lake for Northglenn beyond that amount of water which Northglenn can immediately replace for use by FRICO stockholders.

2. Northglenn at its sole expense will obtain Water Court approval of its plan which is that following beneficial application of the water delivered to Northglenn by FRICO pursuant to this agreement, Northglenn at its sole expense will collect the water, treat it in accordance with FRICO's specifications, store it and transmit it back to the FRICO irrigation network for delivery to FRICO stockholders.

3. Northglenn, pursuant to directions from FRICO, will return all water exchanged pursuant to this agreement acre-foot per acre-foot to the FRICO system, via transmission facilities to be constructed by Norghglenn. Net loss to the water supply occasioned by in-city consumption will be made up by Northglenn from direct flow and underground rights which Northglenn presently owns or will acquire for that express purpose. Northglenn may place water into storage in the Bull Canal storage facility or Northglenn Reservoir during times of a free river to supplement FRICO's supply, but only as approved by FRICO. The Bull Canal storage facility referred to in this paragraph shall be constructed at the sole expense of Northglenn and shall be in operating condition prior to the time when FRICO is required to exchange any water with Northglenn.

4. If, as a result of the multiple use of water which is contemplated by this Agreement, FRICO's priority rights to the use of water are threatened with imminent curtailment by a court or other competent authority, then FRICO shall be released from any obligation to exchange water with Northglenn. At such time as Northglenn has resolved any such problems to the satisfaction of FRICO, the water exchange contemplated herein shall be resumed,

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and the obligations of the parties under the contract shall be continued.

5. FRICO shall remain free from any obligation to divert water to Northglenn until such time as Northglenn has completed the construction of all necessary and related collection, storage, treatment, and transmission facilities, and has secured a decree from a court of competent jurisdiction for sufficient direct flow, underground, and storage rights to satisfy the obligations which it incurs under this Agreement, and further has secured from the Water Court, Water Division No. 1, approval of this water exchange Agreement. Furthermore, FRICO remains free from any obligation to deliver to Northglenn any water from Standley Lake at any time that Northglenn does not have in storage and available for immediate delivery to FRICO stockholders 500 acre-feet of water.

6. FRICO shall retain operational control over the release of water from Standley Lake. Before making any diversion to Northglenn, FRICO may require that a minimum of 500 acre-feet of water in excess of the amount then being diverted to Northglenn be present in storage, it being the intent of this provision to insure to FRICO that at no time will there be a deficit of water in storage.

7. As part of the consideration for this Agreement, any decrees for direct flow, underground, or storage rights presently held by Northglenn or acquired by it in the future, in satisfaction of its obligations under this Agreement, may be utilized by FRICO for its own needs consistent with the terms of this Agreement.

8. FRICO shall remain free from any obligation to divert water to Northglenn until such time as the total consideration to which FRICO is entitled under this Agreement is existing and capable of immediate implementation by FRICO. Furthermore, FRICO retains the right to discontinue the diversion of water to Northglenn in the event that Northglenn should fail to satisfy its obligations under this Agreement.

9. It is expressly recognized and understood that the Cities of Thornton and Westminster have commenced condemnation actions against FRICO and its stockholders, describing Standley Lake and the water rights which are referred to in this Agreement, which actions are now pending in the District Court in and for Jefferson County, Colorado. Northglenn acknowledges that it makes this Agreement with full knowledge of the limitations and restrictions imposed upon FRICO by such pending condemnation actions.

10. All administrative and legal expenses incurred pursuant to satisfying the terms and conditions of this Agreement shall be borne by Northglenn and in addition, Northglenn agrees to pay within thirty (30) days after billing from FRICO all administrative and legal expenses up to a maximum of $2,000 incurred by FRICO in the negotiation and preparation of this Agreement and related agreements. Northglenn further agrees, if requested in writing by FRICO to do so, to assume the defense of any litigation against FRICO as a consequence of its entering into this Agreement and to bear all costs directly associated with any such litigation holding FRICO harmless for the same. However, in any litigation commenced against FRICO as a consequence of its entering into this Agreement, counsel representing both FRICO and Northglenn shall have the right to participate.

11. At no time, as a result of this Agreement, does Northglenn acquire any appropriative rights to the water provided by FRICO pursuant to this Agreement. It is expressly recognized and understood, however, that in order to effectuate the intent of the parties to this Agreement, the shareholders of the Standley Lake division of FRICO may desire to cause the creation of an interest in their water rights in favor of the City of Northglenn. Any agreement which may be entered into between the shareholders and the City of Northglenn shall be consistent with the terms and conditions of this Agreement and subsequent addendum thereto.

12. It is expressly recognized and understood that this Agreement shall in no way operate or be construed as a conveyance

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or assignment of any water rights to Northglenn; rather Northglenn agrees to contract with individual FRICO shareholders for the purpose of securing the right to divert and use the water which is contemplated to be exchanged pursuant to this Agreement. During the period in which Northglenn is seeking to obtain the contractual rights to the quantity of water required to satisfy its needs as described in this Agreement, as well as after such contractual rights have been secured, FRICO agrees that it will take all steps necessary to insure the successful implementation of the water exchange system contemplated and described in this Agreement.

13. If by March 2, 1977, Northglenn fails to provide FRICO written evidence of its financial capability to construct or acquire the water supply and all structures necessary to implement this Agreement and the exchange of water contemplated, this Agreement shall automatically terminate and be of no force and effect excepting only as to those obligations of the parties incurred under the terms hereof prior to March 2, 1977, which prior obligations shall remain binding upon the respective parties.

14. Northglenn agrees to commence acquisition and construction of the facilities required to satisfy the terms and provisions hereof by September 2, 1977 and the failure of Northglenn to commence construction of facilities as herein provided shall automatically terminate all of Northglenn's rights and privileges hereunder.

15. The term of this Agreement shall commence on September 2, 1976, and shall be in effect and binding upon the parties for so long as Northglenn shall be in compliance with each of the terms and conditions hereof.

16. If Northglenn requests and agrees to bear all expenses incident thereto, the parties shall immediately begin preparing an addendum to this Agreement setting forth in all necessary detail the structural and operational principles of the proposed water exchange Agreement.

17. If, as a result of FRICO making and entering into this Agreement, any change in FRICO's tax status pursuant to Article X, Section 3, of the Colorado Constitution occurs to FRICO's disadvantage, then Northglenn agrees to assume all FRICO obligations arising directly from the change in its tax status. Provided, however, that should this provision be found to be void as contrary to law or as outside the scope of Northglenn's Home-Rule Authority, the illegality thereof shall not affect any other provision of this Agreement. Provided further that FRICO shall be released from any obligation under this Agreement in the event that Northglenn is prohibited by law from assuming FRICO's tax obligations as contemplated by this provision.

18. The parties will work in cooperation with one another and their respective supportive staffs to insure the design, construction, and operation of a system that will be mutually accommodating and will preserve the intent of the parties as evidenced by this Agreement.

IN WITNESS WHEREOF, the parties have executed the foregoing Agreement in duplicate original counterparts on the day first above written.

Attest:

Barbara Gurr
Secretary

THE FARMERS RESERVOIR AND IRRIGATION COMPANY

By [illegible]
[illegible], President

Attest:

Marjorie A. Foster
Clerk

CITY OF NORTHGLENN

By: Alvin B. Thomas
Alvin B. Thomas, Mayor

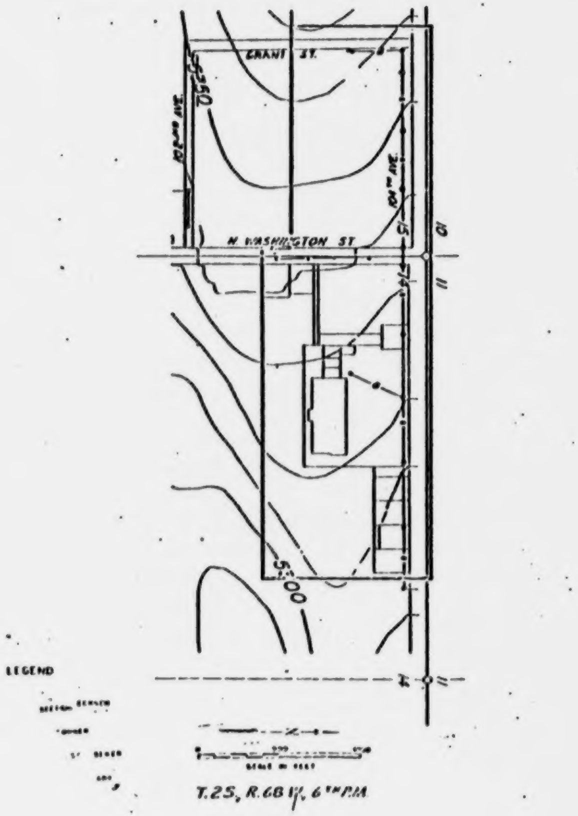
By: [illegible]
Harold T. Hodges, Mayor Pro Tem

Sept 9, 1976

FIGURE - 4
EXHIBIT B

WOOLCO - TARGET AREA

A PORTION OF THE NORTH 1/2 NORTHWEST 1/4 SECTION 14 AND THE NORTHEAST 1/4 NORTHEAST 1/4 SECTION 15, TOWNSHIP 2 SOUTH, RANGE 68 WEST, 6th PRINCIPAL MERIDIAN, AS DELINEATED BELOW.


GRANT ST.
5350
104th AVE.
N WASHINGTON ST
10
11
15
14
5300
LEGEND
SCALE IN FEET
T.2S, R.68 W, 6TH P.M.

"EXHIBIT C"

COUNCILMAN ______________

COUNCILMAN'S BILL ORDINANCE NO.

NO. __________________ __________________
Series of Series of

AN ORDINANCE FOR THE PROTECTION OF THE NORTHGLENN PUBLIC SEWERS BY ESTABLISHING RESTRICTIONS ON THEIR USE, BY SETTING STANDARDS FOR CONNECTIONS, AND BY REGULATING THE DISCHARGE AND PRETREATMENT OF INDUSTRIAL WASTES:

BE IT ORDAINED BY THE CITY COUNCIL OF THE CITY OF NORTHGLENN, COLORADO

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ARTICLE I

INTENT AND PURPOSE

Section 1. Intent and Purpose

(a) It is the intent and purpose of the City of Northglenn (the "City") to protect the public health, safety, and welfare of its citizens by providing a sewer system that is adequately maintained and properly utilized.

(b) It is the intent of the City to build, operate and maintain a public sanitary sewer system for the benefit of its citizens.

(c) Provision has been made in the design, construction and operation of such facilities to accommodate certain types and quantities of industrial wastes in addition to normal wastewater; and the City believes it is the obligation of the producers of industrial waste to defray the costs of the wastewater treatment services rendered by the City of Northglenn in an equitable manner and, insofar as it is practicable, in proportion to benefits derived.

In addition, protection of the quality of the effluent and proper operation of the wastewater collection and treatment facilities and quality of effluent may require either the exclusion, pretreatment, or controlled discharge at point of origin of certain types or quantities of industrial wastes.

(d) It is the desire of the City to partially finance the public sanitary sewer system with a construction grant from the United States Environmental Protection Agency (the "EPA"); and whereas the EPA requires a sewer use and pretreatment ordinance as a condition of the construction grant, it is therefore the intent of the City to comply with that condition, and with all other provisions of the Clean Water Act. (33 U.S.C. §§1251 (et. seq.)

ARTICLE II

DEFINITIONS

Unless the context specifically indicates otherwise, the meaning of terms used in this ordinance shall be as follows:

1. "Biochemical oxygen demand" (BOD) shall mean the quantity of oxygen utilized in the biochemical oxidation of organic matter under standard laboratory procedure in five (5) days at 20 degrees Centigrade, expressed in milligrams per liter.

2. "Building drain" shall mean that part of the lowest horizontal piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer, beginning five (5) feet (1.5 meters) outside the inner face of the building wall.

3. "Building sewer" shall mean the extension from the building drain to the public sewer or other place of disposal, also called house lateral and house connection.

4. "City" shall mean the City of Northglenn, Colorado, or any authorized person acting in its behalf.

5. "C.O.D." (Chemical Oxygen Demand) shall mean the measure of oxygen consuming capacity of inorganic and organic matter present in the water or wastewater expressed in mg/l as the amount of oxygen consumed from a chemical oxidant in a specific test, but not differentiating between stable and unstable organic matter and thus not necessarily correlating with biochemical oxygen matter.

6. "Combined sewer" shall mean a sewer intended to receive both wastewater and storm or surface water.

7. "Control Manhole" shall mean a manhole giving access to a building sewer at some point before the building sewer discharge mixes with other discharges in the public sewer.

8. "Control Point" shall mean a point of access to a course of discharge before the discharge mixes with other discharges in the public sewer.

9. "Director" shall mean the Director of Public Work of the City of Northglenn or his duly authorized representative.

10. "Easement" shall mean an acquired legal right for the specific use of land owned by others.

11. "Floatable oil" is oil, fat, or grease in a physical state such that it will separate by gravity from wastewater by treatment in an approved pretreatment facility. A wastewater shall be considered free of floatable fat if it is properly pretreated and the wastewater does not interfere with the collection system.

12. "Garbage" shall mean animal and vegetable wastes and residue from preparation, cooking, and dispensing of food; and from the handling, processing, storage and sale of food products and produce.

13. "Industrial wastes" shall mean wastes resulting from any process of industry, manufacturing, trade or business, from the development of any natural resource, or any mixture of these wastes with water or normal wastewater.

14. "May" is permissive (see "shall," Sec. 23).

15. "Natural outlet" shall mean any outlet, including storm sewers and combined sewer overflows, into a watercourse, pond, ditch, lake, or other body of surface or groundwater.

16. "Overload" shall mean the imposition of organic or hydraulic loading on a treatment facility in excess of its engineered design capacity.

17. "Person" shall include any individual, corporation, organization, government or governmental subdivision or agency, business trust, estate, trust, partnership, association, and any other legal entity.

18. "pH" shall mean the logarithm of the reciprocal of the hydrogenion concentration. The concentration is the weight of hydrogen ions, in grams, per liter of solution. Neutral water, for example, has a pH value of 7 and a hydrogen-ion concentration of 10^{-7}.

19. "Public sewer" shall mean a common sewer controlled by a governmental agency or public utility.

20. "Sanitary sewer" shall mean a sewer that carries liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions together with minor quantities of ground, storm, and surface waters that are not admitted intentionally.

21. "Sewage" is the spent water of a community. The preferred term is "wastewater," Section 24.

22. "Sewer" shall mean a pipe or conduit that carries wastewater or drainage water.

23. "Shall" is mandatory (see "may," Sec. 14).

24. "Slug" shall mean any discharge of water or wastewater which in concentration of any given constituent or in quantity of flow exceeds for any period of duration longer than fifteen (15) minutes more than five (5) times the average twenty-four (24) hours concentration or flows during normal operation and shall adversely affect the collection system and/or performance of the wastewater treatment works.

25. "Standard Methods" shall refer to the latest edition of "Standard Methods for the Examination of Water and Waste Water" published by the American Public Health Association.

26. "Storm drain" (sometimes termed "storm sewer") shall mean a drain or sewer for conveying water, groundwater, subsurface water, or unpolluted water from any source, and into which domestic wastewater or industrial wastes are not intentionally passed.

27. "Suspended solids" shall mean total suspended matter that either floats on the surface of, or is in suspension in water, wastewater, or other liquids, and that is removable by laboratory filtering as prescribed in "Standard Methods" and referred to as nonfilterable residue.

28. "To discharge" includes to deposit, conduct, drain, emit, throw, run, allow to seep, or otherwise release or dispose of, or allow, permit, or suffer any of these acts or omissions.

29. "Trap" means a device designed to skim, settle, or otherwise remove grease oil, sand, flammable wastes or other harmful substances.

30. "Unpolluted water" is water of quality equal to or better than the effluent criteria in effect or water that would not cause violation of receiving water quality standards and would not be benefited by discharge to the sanitary sewers and wastewater treatment facilities provided.

31. "Waste" shall mean rejected, unutilized or superfluous substances in liquid, gasious, or solid form resulting from domestic, agricultural, or industrial activities.

32. "Wastewater" shall mean the spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and stormwater that may be present.

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33. "Wastewater facilities" shall mean the structures, equipment, and processes required to collect, carry away, and treat domestic and industrial wastes and dispose of the effluent.

34. "Wastewater treatment works" shall mean an arrangement of devices and structures for treating wastewater, industrial wastes, and sludge. Sometimes used as synonymous with "waste treatment plant" or "wastewater treatment plant" or "water pollution control plant."

35. "Watercourse" shall mean a natural or artificial channel for the passage of water either continuously or intermittently.

36. "A.S.T.M." shall mean the American Society Testing Materials.

37. "W.P.C.F." shall mean theWater Pollution Control Federation.

ARTICLE III

USE OF PUBLIC SEWER REQUIRED

Section 1. Waste Disposal.

(a) It shall be unlawful for any person to place, deposit, or permit to be deposited in any unsanitary manner on public or private property within the City of Northglenn (the "City") or in any area under the juridiction of said City, any human or animal excrement, garbage, or other objectionable waste.

(b) Unless exception is granted by the Director, or unless otherwise controlled by state or federal law, all discharges of wastewater, industrial waste, or other polluted liquids shall be to the public sanitary sewer system.

(c) The Director shall verify prior to discharge that wastes authorized to be discharged will receive suitable treatment within the provisions of laws, regulations, ordinances, rules and orders of federal, state and local governments.

Section 2. Unlawful Discharge.

It shall be unlawful to discharge to any natural outlet, water course, or storm sewer within the City or in any area within the jurisdiction of the City, any wastewater, industrial waste, or other polluted liquids except where suitable treatment has been provided in accordance with subsequent provisions of this ordinance, and state and federal law.

Section 3. Prohibitions Except Sewers.

Except as hereinafter provided, it shall be unlawful to construct or maintain any privy, privy vault, septic tank, cesspool, or other facility intended or used for the disposal of wastewater.

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Section 4. Connectio o Sewer.
The owners of all houses, buildings, or properties used for human occupancy, employment, recreation, or other related purposes, situated within the City and abutting on any street, alley, or right-of-way in which there is now located or may in the future be located a public sanitary or combined sewer of the City, is hereby required to install suitable toilet facilities therein. In addition, the owner must also connect such facilities directly with the proper public sanitary sewer in accordance with the provisions of this ordinance and with Northglenn Municipal Code, Section 16-11-3 within 120 days after date of official notice to do so, provided that said public sanitary sewer is within 400 feet of the property line. All facilities and connections required by this ordinance will be at the owner's expense.

ARTICLE IV

IVATE WASTEWATER DISPOSA

Section 1. Public Sewer Not Available.
Where a public sanitary or combined sewer is not available under the provisions of Article III, Section 4, the building sewer shall be connected to a private wastewater disposal system complying with the provisions of this article.

Section 2. Permit for Private System.
Before commencement of construction of a private wastewater disposal system the owner shall first obtain a written permit signed by the Director of the Department of Public Works (the "Director"). The application for such permit shall be made on a form furnished by the City, which the applicant shall supplement by any plans, specifications, and other information as are deemed necessary by the Director. A permit and inspection fee of $_____ shall be paid to the City at the time the application is filed.

Section 3. Final Inspection by Director.
A permit for a private wastewater disposal system shall not become effective until the installation is completed to the satisfaction of the Director. The Director shall be allowed to inspect the work at any stage of construction, and, in any event, the applicant for the permit shall notify the Director when the work is ready for final inspection, and before any underground portions are covered.
After notification, the Director shall inspect the system within ____________ days.

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Section 4. Specifications.

The type, capacities, location, and layout of a private wastewater disposal system shall comply with all recommendations and regulations of the Colorado Department of Health and Adams County. No permit shall be issued for any private wastewater disposal system employing subsurface soil absorption facilities where the area of the lot is less than ____ square feet. No septic tank or cesspool shall be permitted to discharge to any natural outlet.

Section 5. Mandatory Connections.

At such time as a public sanitary sewer becomes available to a property served by a private wastewater disposal system, as provided in Article III, Section 4, a direct connection shall be made to the public sewer within 120 days in compliance with this ordinance. Any septic tanks, cesspools, and similar private wastewater disposal facilities shall be cleaned of sludge and filled with suitable material.

Section 6. Private Maintenance.

The owner shall operate and maintain the private wastewater disposal facilities in a sanitary manner at all times, at no expense to the City.

Section 7. Additional Requirements.

No statement contained in this article shall be construed to interfere with any additional requirements that may be imposed by the Director or local, county, and state health officials.

ARTICLE V

SANITARY SEWERS, BUILDING SEWERS AND CONNECTION

Section 1. Disturbance of Public Sewers.

No unauthorized person shall uncover, make any connections with or opening into, use, alter, or disturb any public sewer or sanitary sewer or appurtenance thereof without first obtaining a written permit from the Director.

Section 2. Sewer Permits.

There shall be two (2) classes of building sewer permits: (a) for residential and commercial service, and (b) for service to establishments producing industrial wastes. In either case, the owner or his agent shall make application on a form furnished by the City. The permit application shall be supplemented by any plans, specifications, or other information considered pertinent in the judgment of the Director. A permit and inspection fee of $_____ for a residential or commercial building sewer permit and $_____ for an industrial building sewer permit shall be paid to the City at the time the application is filed.

Section 3. Owner Costs.

All costs and expense incidental to the installation and connection of the building sewer shall be borne by the owner. The owner shall indemnify the City from any loss or damage that may directly or indirectly be occasioned by the installation of any building sewer.

Section 4. Separate and Multiple Sewers.

A separate and independent building sewer shall be provided for every building; except where one building stands at the rear of another on an interior lot and no private sewer is available or can be constructed to the rear building through an adjoining alley, court, yard, or driveway. In that case, the building sewer from the front building may be extended

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to the rear building and the whole considered as one building sewer. The City does not and will not assume any obligation or responsibility for damage caused by or resulting from any such single connection.

Section 5. Old Sewers.

Old building sewers may be used in connection with new buildings only when they are found, on examination and test by the Director, to meet all requirements of this ordinance.

Section 6. Specifications.

The size, slope, alignment and materials of construction of all sanitary sewers including building sewers, and the methods to be used in excavating, placing of the pipe, jointing, testing, and backfilling the trench, shall all conform to the requirements of the building and plumbing code or other applicable rules and regulations of the City. In the absence of suitable code provisions or in amplification thereof, the materials and procedures set forth in appropriate specifications of the A.S.T.M. and W.P.C.F. Manual of Practice No. 9 shall apply.

Section 7. Building Sewer Level.

Whenever possible, the building sewer shall be brought to the building at an elevation below the basement floor. In all buildings in which any building drain is too low to permit gravity flow to the public sanitary sewer, sanitary sewage carried by such building drain shall be lifted by an approved means and discharged to the building sewer.

Section 8. Runoff Connections Prohibited.

No person shall make connection of roof downspouts, foundation drains, areaway drains, or other sources of surface runoff or groundwater to a building sewer or building drain which in turn is connected directly or indirectly to a public sanitary sewer unless such connection is approved by the Director for purposes of disposal of polluted surface drainage.

Section 9. Connection of Building to Public Sewer.

The connection of the building sewer into the public sanitary sewer shall conform to the requirements of the building and plumbing code or other applicable rules and regulations of the City, or the procedures set forth in appropriate specifications of the A.S.T.M. and the W.P.C.F. Manual of Practice No. 9. All such connections shall be made gastight and watertight and verified by proper testing. Any deviation from the prescribed procedures and materials must be approved by the Director before installation.

Section 10. Inspection Prior to Connection.

The applicant for the building sewer permit shall notify the Director when the building sewer is ready for inspection and connection to the public sanitary sewer. The connection and testing shall be made under the supervision of the Director or his representative.

Section 11. Protection and Restoration.

All excavations for building sewer installation shall be adequately guarded with barricades and lights so as to protect the public from hazard. Streets, sidewalks, parkways, and other public property disturbed in the course of the work shall be restored in a manner satisfactory to the City.

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ARTICLE VI

USE OF THE PUBLIC SANITARY SEWERS

Section 1. Prohibition of Stormwater Discharge to Sanitary Sewers.

No person shall discharge or cause to be discharged any unpolluted waters such as stormwater, surface water, groundwater, roof runoff, subsurface drainage, or cooling water to any public sanitary sewer, except stormwater runoff from limited areas. Such stormwater, which may be polluted at times, may be discharged to the public sanitary sewer only by permission of the Director.

Section 2. Stormwater Discharge.

Stormwater other than that exempted under Section 1, Article VI and all other unpolluted drainage shall be discharged to such sewers as are specifically designated as combined sewers or storm sewers, or to a natural outlet approved by the Director. Unpolluted industrial cooling water or process waters may be discharged, on approval of the Director, to a storm sewer, combined sewer, or natural outlet.

Section 3. Prohibited Discharges - General.

(a) No person shall discharge or cause to be discharged any of the following described liquids or wastes to any public sanitary sewers:

(1) Any gasoline, benzene, naphtha, fuel oil, or other flammable or explosive liquid, solid, or gas.

(2) Any waters containing toxic or poisonous solids, liquids, or gases in sufficient quantity, either singly or by interaction with other wastes, to injure or interfere with any sewage treatment process, constitute a hazard to humans or animals, create a public nuisance, or create any hazard in the receiving waters of the wastewater treatment plant.

(3) Any waters or wastes having a pH lower than 5.5 or having a pH higher than 9.5; or having any other corrosive capable of causing damage or hazard to structures, equipment, and personnel of the wastewater works.

(4) Any waters used for the purpose of diluting wastes which would exceed applicable maximum concentrations limitations.

(5) Wastes, other than domestic sewage, from any hospital, mercantile, manufacturing or industrial establishment, or any steam, hot gases or vapors, grease fats, oils, acids, carbon, iron, or mineral wastes, or any other wastes which would tend to obstruct the public sewer, to be injurious to the public health, create odors, be determental to the sewerage works, or which would interfere with the proper repair or maintenance of the severage system, the operation and maintenance of the disposal works or the proper treatment of domestic sewage, or which results after treatment in an effluent which is detrimental to life or health.

(6) Objectionable or toxic substances, exerting an excessive chlorine requirement or to such degree that any such material received in the composite wastewater at the wastewater treatment works exceeds any limitations established by the Director for such materials.

(7) Wastewater from industrial plants containing floatable oils.

(8) Any radioactive wastes or isotopes of such half-life or concentration as may exceed limits established by the Director or other proper authorities in compliance with applicable state of federal regulations.

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(9) Quantities of flow, concentrations, or both which constitute a "slug" as defined in Article II, Section 24.

(10) Waters or wastes containing substances which are not amenable to treatment or reduction by the wastewater treatment processes employed, or are amenable to treatment only to such degree that the wastewater treatment plant effluent cannot meet the requirements of other agencies having jurisdiction over discharge to the receiving waters. Any water or wastes which, by interaction with other water or wastes in the public sanitary sewer system, release obnoxious gases, form suspended solids which interfere with the collection system, or create a condition deleterious to structures and treatment processes.

(11) All waste, wastewater, or other substances containing phenols, hydrogen sulfide, or other taste-and-odor producing substances, which do not conform to concentration limits as to be established by the Director. After treatment of the composite wastewater, concentration limits may not exceed the requirements established by state, federal, or other agencies with jurisdiction over discharges to receiving waters.

(12) No person may discharge garbage into public sewers unless it is shredded to a degree that all particles can be carried freely under the flow conditions normally prevailing in public sewers. Particles greater than one-half (1/2) inch in any dimension are prohibited. The Director is entitled to review and approve the installation and operation of any garbage grinder equipped with a motor of three-fourths (3/4) horsepower (0.76 hp metric) or greater.

(b) Garbage grinders may be connected to sanitary sewers from homes, hotels, institutions, restaurants, hospitals, catering establishments, or similar places where garbage originates from the preparation of food in kitchens for the purpose of consumption on the premises or when served by caterers.

Section 4. Prohibited Discharges - Specific.

(a) The following described substances, materials, waters, or waste shall be limited in discharges to the public sanitary sewer to concentrations or quantities listed below. The Director may set limitations lower than the limitations established in the regulations below if in his opinion more severe limitations are necessary for the prevention of harm to either the sewers, wastewater treatment process or equipment, to prevent an adverse effect on the receiving stream, or to not otherwise endanger lives, limb, or public property, or constitute a nuisance. In forming his opinion as to the acceptability, the Director will give consideration to such factors as the quantity of subject waste in relation to flows and velocities in the sewers, materials of construction of the sewers, the wastewater treatment process employed, capacity of the wastewater treatment plant, and other pertinent factors. The limitations or restrictions on materials or characteristics of waste or wastewaters discharged to the public sanitary sewer which shall not be violated without approval of the Director are as follows:

(1) Wastewater having a temperature higher than 150° Fahrenheit (65° Celsius), or any substance which causes the temperature of the total wastewater treatment plant influent to increase at a rate of ten (10) degrees Fahrenheit or more per hour, or a combined total increase of plant influent temperature to one hundred ten (110) degrees Fahrenheit.

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(2) [illegible] than ______ mg/l;

(3) [illegible] other than that contained in the public water [illegible]

(4) Chlorides in concentrations greater than 250 mg/l;

(5) Substances causing an excessive Chemical Oxygen Demand (C O

(6) Strong acids, iron pickling wastes, or concentrated plating solutions whether neutralized or not;

(7) Fats, wax, grease or oils, whether emulsified or not, in excess of one hundred (100) mg/l or containing substances which may solidify or become viscous at temperatures between thirty-two (32) and one hundred fifty (150) degrees Fahrenheit ([illegible] and [illegible] Centigrade);

(8) Wastewater containing more than 25 milligrams per liter of petroleum oil, nonbiodegradable cutting oils, or products of mineral oil origin.

(9) The maximum allowable concentrations of heavy metals stated in terms of milligrams per liter (mg/l), determined on the basis of individual sampling in accordance with Standard Methods [illegible]

[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;
[illegible] ______ mg/l;

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(10) Additional prohibited heavy metals and toxic materials include but are not limited to:

Antimony,
Beryllium,
Bismuth,
Cobalt,
Molybdenum,
Uranyl ion,
Rhenium,
Strontium,
Tellurium,
Herbicides,
Fungicides, and
Pesticides.

(b) The elements and limits set forth in this section may be deleted, added to or amended from time to time as is deemed necessary by the Director and/or mandated by federal, state or local laws and regulations.

Section 5. Impairment of Facilities.

(a) No person may discharge into public sewers any substance capable of causing:

(1) obstruction to the flow in sewers;

(2) interference with the operation of treatment processes of facilities; or

(3) excessive loading of treatment facilities.

(b) Discharges prohibited by Section 4(a) include, but are not limited to materials which exert or cause concentrations of:

(1) inert suspended solids greater than 250 mg/l including but not limited to:

(A) Fuller's earth;

(B) lime slurries; and

(C) lime residues;

(2) dissolved solids greater than _____ mg/l including but not limited to:

(A) sodium chloride; and

(B) sodium sulfate;

(3) excessive discoloration including but not limited to

(A) dye wastes; and

(B) vegetable tanning solutions; or

(4) BOD, COD, or chlorine demand in excess of normal plant capacity.

(c) No person may discharge into public sewers any substance that may:

(1) deposit grease or oil in the sewer lines in such a manner as to clog the sewers;

(2) overload skimming and grease handling equipment;

(3) pass to the receiving waters without being effectively treated by normal wastewater treatment processes due to the nonamenability of the substance to bacterial action; or

(4) deleteriously affect the treatment process due to excessive quantities.

(d) No person may discharge any substance into public sewers which:

(1) is not amenable to treatment or reduction by the processes and facilities employed; or

(2) is amenable to treatment only to such a degree that the treatment plant effluent cannot meet the requirements of other agencies having jurisdiction over discharge to the receiving waters.

(e) The Director shall regulate the flow and concentration of slugs when they may

(1) impair the treatment process;

(2) cause damage to collection facilities;

(3) incur treatment costs exceeding those for normal wastewater; or

(4) render the waste unfit for stream disposal agricultural or industrial use.

(f) No person may discharge into public sewers solid or viscous substances which may violate subsection (a) of this section if present in sufficient quantity or size including but not limited to ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastics, wood, unground garbage, whole blood, paunch manure, hair and fleshings, entrails, paper products, either whole or ground by garbage grinders, slops, chemical residues, paint residues, or bulk solids.

Section 6. Maintenance of Equipment.

Any equipment or facilities necessitated by this ordinance, either expressly or implied, shall be maintained continuously in satisfactory condition and be effectively operated by the owner at his expense.

Section 7. Director Requirements.

(a) If discharges or proposed discharges to the public sanitary sewers may:

(1) deleteriously affect wastewater facilities, processes, equipment, or receiving waters; or

(2) create a hazard to life or health; or

(3) create a public nuisance; or

(4) are otherwise contrary to this ordinance;

the Director may require any or all of the following:

(A) pretreatment to an acceptable condition for discharge to the public sewers;

(B) control over the quantities and rates of discharge;

(C) payment to cover the cost of handling and treating the wastes;

(D) rejection of the wastes.

(b) When considering the alternatives in subsection (a), the Director shall give consideration to the economic impact of each alternative on the discharger. If the Director permits the pretreatment or equalization of waste flows, the design and installation of the plants and equipment shall be subject to the review and approval of the Director.

(c) The Director shall determine whether a discharge or proposed discharge is included under subsection (a) of this section.

(d) The Director shall reject wastes when he determines that a discharge or proposed discharge is included under subsection (a) of this section; and the discharger does not meet the requirements of subsection (a) of this section.

(e) Any person responsible for discharges through a building sewer carrying industrial wastes shall, at his own expense and as required by the Director:

(1) [illegible] suitable and safely located control manhole;

(2) install meters and other appurtenances to facilitate observation, sampling, and measurement of the waste; and

(3) maintain the equipment and facilities.

Section 8. Discharges Requiring a Trap.

(a) Discharges requiring a trap include: grease or waste containing grease in excessive amounts; oil; sand; flammable wastes; and other harmful ingredients, as determined by the Director.

(b) Any person responsible for discharges requiring a trap shall at his own expense and as required and approved by the Director:

(1) provide equipment and facilities of a type and capacity approved by the Director; and

(2) locate the trap in a manner that provides ready and easy accessibility for cleaning and inspection; and

(3) maintain the trap in effective operating condition.

(c) In the maintenance of these traps, the owner shall be responsible for the proper removal and disposal by appropriate means of the captivated material and shall maintain records of the dates, and means of disposal which are subject to review by the Director. Any removal and hauling of the collected materials not performed by owner personnel must be performed by currently licensed waste disposal firms.

Section 9. Information Requirements.

(a) The Director may require a user of public sanitary sewer services to provide information needed to determine compliance with this ordinance.

(b) These requirements may include, but are not limited to, the following:

(1) wastewaters discharge peak rate and volume over a specified time period;

(2) chemical analyses of wastewaters;

(3) information on raw materials, processes, and products affecting wastewater volume and quality;

(4) quantity and disposition of specific liquid, sludge, oil, solvent, or other materials important to sewer use control,

(5) a plot plan of sewers of the user's property showing sewer and pretreatment facility location;

(6) details of wastewater pretreatment facilities; and

(7) details of systems to prevent and control the losses of materials through spills to the municipal sewer.

Section 10. Standards for Analysis.

(a) All measurements, tests, and analyses of the characteristics of waters and wastes to which reference is made in this ordinance shall be determined in accordance with the latest edition of "Standard Methods

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for the Examination of Water and Wastewater," published by the American Public Health Association.

(b) Sampling methods, location, times, durations, and frequencies are to be determined on an individual basis subject to approval by the Director.

ARTICLE VII

PRETREATMENT REQUIREMENTS

Section 1. Treatment of Industrial Flows.

If it is required by the Director to treat industrial flows prior to discharge to public sewers in order to measure, sample, restrict or prevent the discharge to the sewer of certain waste constituents, to more equally distribute peak discharges of industrial wastewater, or to accomplish any pretreatment result, then all pretreatment systems shall be subject to the approval of the Director who shall assure that such systems are adequately engineered and designed.

Section 2. Federal and State Standards.

All industrial users of public sewers are subject to the following: national and state pretreatment regulations and standards of a general nature; and national and state pretreatment regulations and standards promulgated for specific industries.

Section 3. Municipal Pretreatment Program.

If it is determined by the Regional Administrator of the Environmental Protection Agency or by the Colorado Department of Health that a municipal pretreatment program should be established based on the total design flow of the wastewater facility and the amount of industrial wastes processed, the City shall develop, implement and enforce such a program in compliance with all relevant state and federal statutes and regulations.

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ARTICLE VIII

POWERS AND AUTHORITY OF INSPECTORS

Section 1. Right of Entry.

(a) The Director and other duly authorized employees of the City bearing proper credentials and identification shall be permitted to enter all properties for the purposes of inspection, observation, measurement, sampling, and testing pertinent to discharge to the public sanitary sewer system in accordance with the provisions of this ordinance.

(b) Anyone acting under this authority shall observe the establishment's rules and regulations concerning safety, internal security, and fire protection.

(c) The Director and other duly authorized employees of the City bearing proper credentials and identification are entitled to enter all private properties through which the City holds a negotiated easement for the purposes of:

(1) inspection, observation, measurement, sampling, or repair;

(2) maintenance of any portions of the wastewater facilities lying within the easements; and

(3) conducting any other authorized activity.

All activities shall be conducted in full accordance with the terms of the negotiated easement pertaining to the private property involved.

Section 2. Liability and Indemnification.

While performing the necessary work on private properties referred to in Section 1, subsection (a), above, the company shall be held harmless for injury or death to the City employees, and the City shall indemnify the company against loss or damage to its property by the City employees and against liability claims and demands for personal injury or property

damage asserted against the company growing out of the gauging and sample operation, except as such may be caused by negligence or failure of the company to maintain safe conditions.

Section 3. Industrial Information.

The Director or other duly authorized employees are authorized to obtain information concerning industrial processes which have a direct bearing on the kind and source of discharge to the public sanitary sewer system. Confidential information shall be clearly identified. The industry must establish the confidentiality of such material in accordance with standards established by the State of Colorado.

ARTICLE [illegible]

PENALTIES AND ENFORCEMENT

Section 1. Notice.

Any person found to be in violation of any provision of this ordinance shall be served by the City with written notice stating the nature of the violation and provided a reasonable time limit for the satisfactory correction thereof. The offender shall, within the period of time stated in such notice, permanently cease all violations.

Section 2. Penalties.

Any person who shall continue any violation beyond the time limit provided for in Article IX, Section 1, shall be guilty of a misdemeanor, and on conviction thereof shall be fined in the amount not exceeding Three Hundred Dollars ($300.00) for each violation, or by imprisonment in the City or County jail not to exceed ninety (90) days, or by both fine and imprisonment. Each day in which any violation shall continue shall be deemed a separate offense.

Section 3. Loss to City.

Any person violating any of the provisions of this ordinance shall become liable to the City for any expense, loss or damage occasioned the City by reason of such violation.

Section 4. Destruction of Property.

No person shall maliciously, willfully, or negligently break, damage, destroy, uncover, deface, or tamper with any structure, appurtenance or equipment which is a part of the public sanitary sewer or related wastewater facilities. Any person violating this provision shall be subject to immediate arrest under charge of disorderly conduct.

Section 5. Termination of Service.

(a) The City may terminate water and wastewater disposal service and disconnect any customer from the system when any of the following occurs:

(1) acids or chemicals damaging to sewer lines or treatment process are released to the sewer causing rapid deterioration of these structures or interfering with proper conveyance and treatment of wastewater;

(2) a governmental agency informs the City that the effluent from the wastewater treatment plant is no longer of a quality permitted for discharge to a watercourse, and it is found that the customer is delivering wastewater to the City's system that cannot be sufficiently treated or requires treatment that is not provided by the City as normal domestic treatment.

(b) The City shall continue disconnection until such time as the industrial customer provides additional pretreatment or other facilities designed to remove the objectionable characteristics from the industrial wastes.

Section 6. Other Remedies.

(a) In additon to proceeding under authority of this article, the City is entitled to pursue all other criminal and civil remedies to which it is entitled under authority of statutes or other ordinances against a person continuing prohibited discharges.

(b) In addition to sanctions provided for by this ordinance, the City is entitled to exercise sanctions provided for by the other ordinances of the City for failure to pay the bill for water and sanitary sewer service when due.

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ARTICLE X

VALIDITY

Section 1. Conflicting Ordinances.

All ordinances or parts of ordinances in conflict herewith are hereby repealed.

Section 2. Severability.

In the event any part of this ordinance is held to be unconstitutional by a court of competent jurisdiction or is superseded by state law, the remaining portion of this ordinance shall remain in full force and effect.

Dated at Northglenn, Colorado this _____ day of __________, 197 .

____
Alvin B. Thomas, Mayor

ATTEST:

____
Shirley Whitten, City Clerk

APPROVED AS TO FORM:

____
Charles L. Sharp, Jr., City Attorney

"EXHIBIT D"

Set forth below are the residences and areas in Northglenn to be provided with sewage services by Thornton as set forth in Paragraph 5 hereof. (See attached map which is incorporated herein.)

1. Tolwin Subdivision
   (located in North-Mor Area)

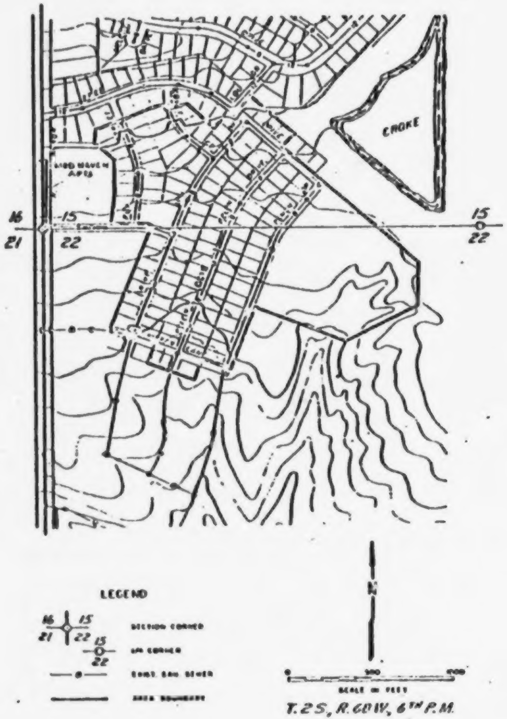
   Block 2, Lots 5 through 10
   Block 3, Lots 4 through 12 and 17 through 23
   Block 4, Lots 6 through 11
   Block 7, Lots 1 through 37
   Block 8, Lots 1 through 34
   Block 10, Lots 2, 3, and 4
   Block 22, Lot 1
   Block 23, Lot 17

2. Deza Estates

   Block 1, Lot 35

NORTH-MOR AREA

A PORTION OF THE SOUTHWEST 1/4, SECTION 15 AND A PORTION OF THE NORTHWEST 1/4, SECTION 22, TOWNSHIP 2 SOUTH, RANGE 68 WEST, 6th PRINCIPAL MERIDIAN



"EXHIBIT E"

A. Utility Extension Policy Contracts

The following are the Utility Extension Policy Contracts ("UEPCs") between the City of Thornton and the Developers of property within the Northglenn City limits.

1. Perl-Mack
    - a. UEPC, dated 03/11/59 (Book 1191, pp. 386-395)
    - b. UEPC, dated 06/15/59 (Book 1191, pp. 396-404)
    - c. UEPC, dated 11/17/60 (Book 1191, pp. 405-412)
    - d. UEPC, dated 05/14/62 (Book 1191, pp. 413-418)
    - e. Addendum, dated 09/30/68 (Book 1466, pp. 381-390)
    - f. Second Addendum, dated 11/19/70 (Book 1647, pp. 75-82
    - g. Third Addendum, dated 03/29/71 (Book 1687, pp. 129-139)
    - h. Amendment to Third Addendum, dated 08/23/71 (Book 1737, pp. 172-175)
    - i. Fourth Addendum, dated 02/11/74 (Book 1914, pp. 936-940), as amended.
2. Transwestern Investment Co.
    - a. UEPC, dated 03/12/56
    - b. Assignment, dated 07/18/61
    - c. Amendment, dated 09/19/61
    - d. Assignment, dated 04/01/63 (Book 1191, pp. 484-487)
    - e. Stipulation and Agreement, dated 06/05/70 (Book 1605, pp. 192-20[illegible])
    - f. Assignment, dated 03/15/73 (Book 2013, pp. 264-268)
    - g. UEPC, dated 06/30/58
3. Tol-Win Corp.
    - a. UEPC, dated 07/20/56 (Book 1191, pp. 471-474)

b. Addendum, dated 03/26/68

c. Amendment to Addendum, dated 05/28/70

d. Second Addendum, dated 02/15/74 (Book 1920, pp. 376-378)

4. Berg & Rollins

   a. UEPC, dated 03/24/69 (Book 1509, pp. 415-423)

   b. Addendum, dated 12/12/69 (Book 1568, pp. 74-75)

   c. Assignment and Acceptance, dated 07/22/75 and 07/23/75 (Book 2023, p. 786)

   d. Assignment and Acceptance, dated 07/23/75 (Book 2023, pp. 784-785)

   e. Assignment and Acceptance, dated 03/30/78 and 04/26/78 (Book 2267, p. 839)

5. Robert Land Co.

   a. UEPC, dated 06/08/70 (Book 1605, pp. 182-191)

6. Martin T. Hart

   a. UEPC, dated 04/08/71 (Book 1687, pp. 140-147)

   b. Assignment, dated 08/08/73

   c. Addendum, dated 10/18/73 (Book 1900, pp. 472-474)

   d. Assignment, dated 03/25/74 (Book 1930, pp. 734-739)

   e. Assignment, dated 01/27/76 (Book 2082, pp. 482-485)

   f. Assignment, dated 01/27/76 (Book 2053, pp. 796-799)

   g. Assignment, dated 08/04/78 (Book 2279, p. 887)

7. Dr. L. E. Adams

   a. UEPC, dated 11/16/67 (Book 1401, pp. 435-436)

8. Mobil Oil Corp.

   a. UEPC, dated 10/07/75 (Book 2023, pp. 778-783)

9. Roy H. and Beverly J. Carlson

   a. UEPC, dated 02/18/71 (Book 1672, pp. 386-394)

10. Webster Lake Land Company, Inc.

    a. UEPC, dated 03/25/74 (Book 1922, pp. 529-533)

    b. Partial Assignment dated 05/21/74

    c. Assignment 08/11/75 (Book 2100, pp. 468)

B. Individual Utility Extension Contracts

These consist of all water and sewer service agreements between the City of Thornton and Northwest Utilities users within the Northglenn City limits.

D-4

IN THE DISTRICT COURT IN AND FOR CLERK

WATER DIVISION NO. 1

STATE OF COLORADO

Case No. 79-CW-235

IN THE MATTER OF THE APPLICATION FOR WATER RIGHTS OF THE CITY OF NORTHGLENN IN THE SOUTH PLATTE RIVER AND ITS TRIBUTARIES IN JEFFERSON, ADAMS AND WELD COUNTIES.	)	APPLICATION FOR CHANGE OF WATER RIGHTS

1. NAME AND ADDRESS OF APPLICANT:

City of Northglenn
%Musick, Williamson, Schwartz, Leavenworth & Cope, P.C.
P.O. Box 4579
Boulder, CO 80306
Telephone: 499-3990

2. DESCRIPTION OF WATER RIGHTS AFFECTED:

(a) Applicant is the owner of shares in the following mutual ditch companies:

(1) Farmers Highline Canal and Reservoir Company. Applicant owns 7.7125 out of 1094 shares, or 0.7% of the company. The company owns the following decreed water rights with a present point of diversion out of Clear Creek. The headgate thereof is located on the north bank of Clear Creek in N. 1/2 of the S.W. 1/4 of Section 27, in Township 3 South, Range 70 West in Jefferson County, Colorado, about eight hundred sixty (860) feet South 7° 30' east (Magnetic bearing) from the N.E. corner of the W. 1/2 of said section 27, in Bush and Fisher's Addition to Golden, four hundred forty seven (447) feet west of the east line of said Addition and four hundred fifty (450) feet south of Platte St. in Water District No. 7.

a. The Wadsworth Ditch, priority no. 1 in former water district no. 7, for 0.276 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of February 25, 1860, decreed on October 4, 1884, transferred to Farmers Highline Canal by decree dated June 6, 1907.

b. The South Side Ditch, priority no. 3 in former water district no. 7, for 1.00 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of May 16, 1860, decreed on October 4, 1884, transferred to Farmers Highline Canal by decree dated April 20, 1909.

c. The Ouelette Ditch, priority no. 5 in former water district no. 7, for 3.281 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of May 31, 1860, decreed on October 4, 1884, transferred to Farmers Highline Canal by decree dated January 22, 1913.

d. The Farmers Highline Canal, priority no. 9 in former water district no. 7, for 39.80 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of July 1, 1860, decreed on October 4, 1884.

e. The Farmers Highline Canal, priority no. 30 in former water district no. 7, for 1.61 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of May 28, 1863, decreed on October 4, 1884, transferred to Farmers Highline Canal by decree dated February 1, 1910.

f. The Slater and Moody Ditch, priority no. 32 in former water district no. 7, for 0.75 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of June 20, 1863, decreed on October 4, 1884, transferred to Farmers Highline Canal by decree dated June 28, 1909.

g. The Slater and Moody Ditch, priority no. 32 in former water district no. 7, for 2.0 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of June 20, 1863, decreed on October 4, 1884.

h. The Juchem and Ouelette Ditch, priority no. 42 in former water district no. 7, for 2.89 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of April 23, 1865, decreed on October 4, 1884, transferred to Farmers Highline Canal by decree dated February 10, 1910.

i. The Wadsworth Ditch, priority no. 48 in former water district no. 7 for 0.808 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of November 2, 1865, decreed on October 4, 1884.

j. The Reno and Juchem Ditch, priority no. 54 in former water district no. 7, for 0.33 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of May 24, 1870, decreed on October 4, 1884, transferred to Farmers Highline Canal by decree dated May 2, 1904.

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k. The Farmers Highline Canal, priority no. 1 in former water district no. 7, for 193.80 cubic feet of water per second for irrigation purposes from Little Dry Creek with an appropriation date of April 1, 1872, decreed on May 13, 1936.

l. The Farmers Highline Canal, priority no. 21 in former water district no. 7 for 60.00 cubic feet of water per second for irrigation purposes from Ralston Creek with an appropriation date of April 1, 1872, decreed on May 13, 1936.

m. The Farmers Highline Canal, priority no. 4 in former water district no. 7, for 465.00 cubic feet of water per second for irrigation purposes from Leyden Creek with an appropriation date of July 12, 1905, decreed on May 13, 1936.

n. The Farmers Highline Canal Enlargement, priority no. 57 in former water district no. 7, for 154.00 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of April 1, 1872, decreed on October 4, 1884.

o. The Farmers Highline Canal, 3rd Enlargement, priority no. 68 in former water district no. 7, for 191.00 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of April 1, 1886, decreed on October 9, 1895.

p. The Farmers Highline Canal, 4th Enlargement, priority no. 69 in former water district no. 7, for 335.86 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of April 23, 1895, decreed on October 9, 1895.

(2) Eastlake Water Company. Applicant owns 117 out of 1441 shares, or 8.12% of the company. The company owns the following decreed water rights with a present point of diversion out of Clear Creek at the Farmers Highline Canal & Reservoir Company set forth above:

a. The Eastlake Reservoir # 1, priority no. 33 in former water district no. 7, for 125 acre feet of water for irrigation and domestic purposes from Clear Creek with an appropriation date of September 1, 1887, decreed on May 13, 1936.

b. The Eastlake Reservoir # 2, priority no. 33 in former water district no. 7, for 800 acre feet of water for domestic and irrigation purposes from Clear Creek with an appropriation date of October 1, 1887, decreed on May 13, 1936.

c. The Eastlake Reservoir # 3, priority no. 49 in former water district no. 7, for 197.95 acre feet of water for domestic and irrigation purposes from Clear Creek with an appropriation date of October 1, 1889, decreed on May 13, 1936.

d. 41 shares in the Farmers Highline Canal and Reservoir Company, *supra*.

(b) Applicant is the owner of the following carrier rights:

(1) The Golden City and Ralston Creek Ditch. Applicant owns the right to purchase 415.295 out of 5710.64 inches of water from the Church Ditch, a carrier ditch, or 7.27% of the company's carrier rights. The Golden City and Ralston Creek Ditch holds the following decreed water rights with a present point of diversion out of Clear Creek and Ralston Creek at a point on the northeast quarter (NE¼) of Section 32, Township 3 South, Range 70 West, Jefferson County, Colorado, 1450 feet South 69° 30' west from the northeast corner of said section. Its headgate on Ralston Creek is located on the north bank of Ralston Creek in Section 2, Township 3 South, Range 70 West, Jefferson County, Colorado, at a point 445 feet South 69° west from the center of said section. Said Church Ditch extends in a general northerly and easterly direction crossing and diverting water from Ralston Creek and passing through the following Sections: 32, 33, 28, 27, 22, 23, 14, 11, 12, 2 and 1, Township 3 South, Range 70 West; Sections 36, 35 and 25 Township 2 South, Range 70 West; and Sections 30, 29, 32, 33, 34, 28, 29, 30, 19, 18, 17, 16, 9 and 8, Township 2 South, Range 69 West.

a. The Swadley Ditch, priority no. 21 in former water district no. 7, for 0.90 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of June 1, 1862, decreed on October 4, 1884, transferred to the Golden City and Ralston Creek Ditch by decree dated September 23, 1912.

b. The Golden City and Ralston Creek Ditch, priority no. 40 in former water district no. 7, for 41.43 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of February 28, 1865, decreed on October 4, 1884.

c. The Swadley Ditch, priority no. 44 in former water district no. 7, for 1.25 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of May 16, 1865, decreed on October 4, 1884, transferred to the Golden City and Ralston Creek Ditch by decree dated September 23, 1912.

d. The Golden City and Ralston Creek Ditch, priority no. 62 in former water district no. 7, for 18.26 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of November 18, 1877, decreed on October 4, 1884.

e. The Golden City and Ralston Creek Ditch, priority no. 65 in former water district no. 7, for 18.85 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of November 15, 1878, decreed on October 4, 1884.

f. The Golden City and Ralston Creek Ditch, priority no. 66 in former water district no. 7, for 32.34 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of November 20, 1881, decreed on October 4, 1884.

g. The Golden City and Ralston Creek Ditch, priority no. 22 in former water district no. 7, for 185.0 cubic feet of water per second for irrigation purposes from Ralston Creek with an appropriation date of November 18, 1877, decreed on May 13, 1936.

h. The Golden City and Ralston Creek Ditch, priority no. 74 in former water district no. 7, for 100.12 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of March 16, 1886, decreed on May 13, 1936.

i. The Golden City and Ralston Creek Ditch, priority no. 74a in former water district no. 7, for 88.27 cubic feet of water per second (conditional) for irrigation purposes from Clear Creek with an appropriation date of March 16, 1886, decreed on May 13, 1936.

j. The Golden City and Ralston Creek Ditch, priority no. 23a in former water district no. 7, for 315.0 cubic feet of water per second (conditional) for irrigation purposes from Ralston Creek with an appropriation date of December 5, 1892, decreed on May 13, 1936.

(c) Applicant owns the following decreed water rights with a present point of diversion out of Current Creeks and the Fraser River with the initial point or headgate of said ditch Canal situated at a point on the right bank of said First Creek whence a monument on James Peak bears North 71° 49' west, East, a monument on Sugarloaf Mountain bears South 25° 52' east and a peak through a gap in the range bears South 74° 52' east; thence said Canal follows a natural contour of the Mountains in a general southerly direction, crossing and taking the waters of Second Creek and its tributaries to a point on Current Creek. The headgate for the waters of Current Creek being located at a point whence the monument of Sugarloaf Mountain bears South 49° 25' east a peak through a gap in the range bears North 69° 58' east and a peak west of James Peak bears North 66° 53' east, from thence the Berthoud Canal follows a natural slope of the mountains crossing tributaries of the Fraser River to the Western portal of the Berthoud Tunnel.

(1) The Berthoud Ditch and Tunnel, priority No. 223A for 53.40 cubic feet per second from the First, Second and Current Creeks and the Fraser River for irrigation purposes with an appropriation date of June 30, 1902, decreed on August 3, 1911.

3. PROPOSED CHANGE OF WATER RIGHTS:

(a) Applicant requests a change in purpose of use of the above described water rights to all beneficial uses including but not by limitation municipal, domestic, industrial, commercial, irrigation, augmentation and exchange.

(b) Applicant requests a change in place of use of the above water rights in the alternative to Northglenn's raw water intake structure located at Standley Lake Reservoir outlet works located approximately 1000 feet north of the quarter corner on the section line between sections 21 and 22, Township 2 South, Range 59 West, 6th Principal Meridian or to all lands capable of being served by said water including the Bull Canal Reservoir Number 8 applied for decree in W-8445.

Dated this 31st day of August, 1979.

MUSICK, WILLIAMSON, SCHWARTZ,
LEAVENWORTH & COPE, P.C.

By John D. Musick
John D. Musick, Jr. (341)

By
Joseph A. Cope (7633)

Post Office Box 4579
Boulder, Colorado 80306
(303) 499-3990

Special Counsel to Applicant
The City of Northglenn, Colorado

STATE OF COLORADO)
) ss.
COUNTY OF ADAMS)

Richard P. Lundahl, being first duly sworn upon oath, deposes and says that he is the Director of Natural Resources for the City of Northglenn, that he has read the foregoing Application for Change of Water Rights, knows the contents thereof, and that the same are true to the best of his knowledge and belief.

Richard P. Lundahl
Richard P. Lundahl

Subscribed and sworn to before me this 31st day of August, 1979.

Notary Public

My commission expires: DECEMBER 13, 1981

D-5

COURT

WATER CLERK

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Case No. 79-CW-236

IN THE DISTRICT COURT IN AND FOR

WATER DIVISION NO. 1

STATE OF COLORADO

Case No. 79-CW-236

IN THE MATTER OF THE APPLICATION)
FOR WATER RIGHTS OF THE CITY OF)
NORTHGLENN)
) APPLICATION FOR APPROVAL
IN THE SOUTH PLATTE RIVER) OF PLAN FOR AUGMENTATION
AND ITS TRIBUTARIES) INCLUDING EXCHANGE
)
IN JEFFERSON, ADAMS AND WELD)
COUNTIES.)

1. NAME AND ADDRESS OF APPLICANT:

City of Northglenn
%Musick, Williamson, Schwartz, Leavenworth & Cope, P.C.
P.O. Box 4579
Boulder, CO 80306
Telephone: 499-3990

2. WATER RIGHTS TO BE AUGMENTED:

(a) Northglenn Reservoir, decreed in Case No. W-113, Water Division No. 1 on October 29, 1971, for 330 acre feet for irrigation, domestic, municipal and all beneficial purposes, from Grange Hall Creek, with a priority date of August 25, 1970.

(b) Northglenn Reservoir Enlargement, decree applied for in Case No. W-8445, Water Division No. 1 for 1700 acre feet for irrigation, domestic, municipal and all beneficial purposes, from Grange Hall Creek, with a priority date of May 6, 1976.

(c) Bull Canal Reservoir No. 8, decree applied for in Case No. W-8445, Water Division No. 1, for 5950 acre feet for irrigation, domestic, municipal and all beneficial purposes, from Big Dry Creek, with a priority date of May 6, 1976.

(d) Northglenn South Platte Wells Number 1-5, decree applied for contemporaneous herewith in an application filed in Water Division No. 1, for a total of 8 cubic feet per second for irrigation, domestic, municipal and all beneficial purposes.

(e) Northglenn Irma Drive Diversion Structure, decree applied for contemporaneous herewith in an application filed in Water Division No. 1, for 15 cubic feet per second, direct flow and 30 acre feet, storage, for irrigation, domestic, municipal and all beneficial purposes.

3. WATER RIGHTS TO BE USED FOR AUGMENTATION:

(a) Mutual Ditch Companies:

(1) Lower Clear Creek Ditch Company. Applicant owns 8 out of 320 shares, and also 40 out of 300 inches of carrier rights, which amounts to 4.21% of this company's water supply. The company owns the following decreed water rights:

a. The Clear Creek and Platte River Ditch, priority no. 18 in former water district no. 7, for 49.50 cubic feet of water per second for irrigation purposes from Clear Creek with an appropriation date of November 1, 1861, decreed on October 4, 1884.

(2) Wellington Reservoir Company. Applicant owns or has contracted to purchase 157 out of 1833 shares, or 10.79% of the company. The company owns the following decreed water rights:

a. The Wellington Reservoir, priority no. 416 in former water district no. 23, for 2747.72 acre feet of water for irrigation purposes from Buffalo Creek with an appropriation date of May 31, 1892, decreed on June 21, 1922.

b. The Wellington Reservoir Enlargement, priority no. 427 in former water district no. 23, for 3590 acre feet of water (conditional) for irrigation purposes from Buffalo Creek with an appropriation date of June 5, 1920, decreed on June 21, 1922.

c. The Craig Meadows Reservoir, priority no. 36 in former water district no. 23, for 15,000 acre feet of water (conditional) for domestic and irrigation purposes from Craig Creek with an appropriation date of June 12, 1962, decreed on April 27, 1972.

d. The Duggan Ditch, priority no. 7 in former water district no. 2, for 7.987 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of April 1, 1864, decreed on April 28, 1883, transferred to the Burlington Ditch by decree dated April 27, 1923.

(3) Burlington Ditch, Reservoir and Land Company, Little Burlington Division. Applicant owns or has contracted to purchase 165 out of 1887.67 shares, or 10.94% of this division of the company. The Little Burlington Division owns the following decreed water rights:

a. The Duggan Ditch, priority no. 7 in former water district no. 2, for 16.28 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of April 1, 1864, decreed on April 28, 1883.

b. The Burlington Ditch, priority no. 57 in former water district no. 2, for 350 cubic feet of water per second for irrigation and domestic purposes from the South Platte River with an appropriation date of November 20, 1885, decreed on July 8, 1893.

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c. The Burlington Ditch, priority no. 1 in former water district no. 2, for 250 cubic feet of water per second for irrigation, domestic and storage purposes from Sand Creek with an appropriation date of December 1, 1885, decreed on July 8, 1893.

d. The Burlington Ditch, priority no. 1 in former water district no. 2, for 50 cubic feet of water per second for irrigation, domestic and storage purposes from First Creek with an appropriation date of September 1, 1886, decreed on July 8, 1893.

e. The Burlington Ditch, priority no. 1 in former water district no. 2, for 250 cubic feet of water per second for irrigation, domestic and storage purposes from Second Creek with an appropriation date of November 15, 1886, decreed on July 8, 1893.

f. The Burlington Ditch, priority no. 1 in former water district no. 2, for 250 cubic feet of water per second for irrigation purposes from Third Creek with an appropriation date of September 15, 1887, decreed on July 8, 1893.

g. The Altura Reservoir, (a/k/a Duck Lake), priority no. 403 in former water district no. 23, for 750 acre feet of water for irrigation purposes from Geneva Creek with an appropriation date of September 15, 1904, decreed on May 18, 1918.

(4) Fulton Irrigating Ditch Company. Applicant owns 143 out of 7185 shares, or 1.99% of this company. The company owns the following decreed water rights:

a. The Fulton Ditch, priority no. 8 in former water district no. 2, for 79.70 cubic feet of water per second for irrigation purposes from the South Platte river with an appropriation date of May 1, 1865, decreed on April 28, 1883.

b. The Fulton Ditch, 1st Enlargement, priority no. 43 in former water district no. 2, for 74.25 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of July 8, 1876, decreed on April 28, 1883.

c. The Fulton Ditch, 2nd Enlargement, priority no. 51 in former water district no. 2, for 50.23 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of November 5, 1879, decreed on April 28, 1883.

(5) New Brantner Extension Ditch Company. Applicant owns or has contracted to purchase 3 out of 300 shares, or 1.0% of the company, plus the right to receive water for the irrigation of 50 acres of land from this company's "Old Brantner" water rights. The company owns the following decreed water rights:

a. The Brantner Ditch, priority no. 1 in former water district no. 2, for 29.77 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of April 1, 1860, decreed on April 28, 1883.

b. The Brantner Ditch, 1st Enlargement, priority no. 4 in former water district no. 2, for 5.93 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of May 1, 1863, decreed on April 28, 1883.

c. The Brantner Ditch, 2nd Enlargement, priority no. 27 in former water district no. 2 for 12.18 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of July 1, 1872, decreed on April 28, 1883.

d. The Brantner Ditch, 3rd Enlargement, priority no. 52 in former water district no. 2, for 63.30 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of January 15, 1881, decreed on April 28, 1883.

(6) The Lupton Bottom Ditch Company. Applicant owns 7 out of 84 shares, or 8.33% of the company. The company owns the following decreed water rights:

a. The Lupton Bottom Ditch , priority no. 5 in former water district no. 2, for 47.70 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of May 15, 1863, decreed on April 28, 1883.

b. The Ellwood Ditch, priority no. 20 in former water distict no. 2, for 10.00 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of March 10, 1871, decreed on April 28, 1883, transferred to the Lupton Bottom Ditch by decree dated April 16, 1927.

c. The Lupton Bottom Ditch, 1st Enlargement, priority no. 31 in former water district no. 2, for 92.87 cubic feet of water per second for irrigation purposes from the South Platte River with an appropriation date of September 15, 1873, decreed on April 28, 1883.

(b) Decreed water rights:

(1) Reithmann Ditch, 3.0 cubic feet per second from the South Platte River for irrigation purposes with an appropriation date of June 1, 1862, decreed August 14, 1918. Applicant owns 91/135 of 2.0 c.f.s. of this water right or 1.35 c.f.s.

(2) Northglenn Arapahoe Aquifer Wells No. 1-10, decree applied for in Case No. W-8445, Water Division No. 1, for a total of 2.22 cubic feet per second for irrigation domestic, municipal and all beneficial purposes.

(3) Northglenn Laramie-Fox Hills Aquifer Wells No.1-10, decree applied for In Case No. W-8445, Water Division No. 1, for a total of 3.33 cubic feet per second for irrigation, domestic, municipal and all beneficial purposes.

(4) Northglenn Shopping Center Runoff, decreed in Case No. W-231 Water Division No. 1 on March 3, 1971, for 290 cubic feet per second for irrigation, domestic, municipal and all beneficial purposes, from Grange Hall Creek, with priority date of May 13, 1970.

(5) Thede Ditch. Priority No. 3 in former water district No. 2, for 0.26 cubic feet per second from Grange Hall Creek, a/k/a Brewers Gulch, for irrigation purposes with an appropriation date of April 1, 1885, decreed May 20, 1914.

(6) Griebling Ditch. Priority No. 4 in former water district no. 2 for 1.0 cubic feet per second from Grange Hall Creek, a/k/a Brewers Gulch, for irrigation purposes with an appropriation date of July 4, 1885, decreed May 20, 1914.

(c) Storage reservoirs:

(1) Lutz Reservoir. Applicant has contracted to purchase this reservoir. The reservoir is located in the Southeast Quarter of Section 20, Township 2 South, Range 67 West of the 6th P.M., Adams County, and is filled by the Burlington Ditch.

(2) Webster Lake. Applicant is the owner of this reservoir by conveyance from the Northglenn Metropolitan Recreation District. The reservoir is located in the NW¼ and NE¼, Section 3, Township 2 South, Range 68 West of the 6th P.M., Adams County, and is filled by the Farmers Highline Canal.

(3) Huron Lake. Applicant is the owner of this reservoir by conveyance from the Northglenn Metropolitan Recreation District. The reservoir is located in the NW¼, Section 10, Township 2 South, Range 68 West of the 6th P.M., Adams County, and is filled by the Farmers Highline Canal.

4. COMPLETE STATEMENT OF PLAN FOR AUGMENTATION, INCLUDING TERMS AND CONDITIONS WHICH WOULD PREVENT INJURY TO OWNERS OF OR PERSONS ENTITLED TO USE WATER UNDER VESTED WATER RIGHTS OR DECREED CONDITIONAL WATER RIGHTS:

(a) Description of Project.

Applicant is engaged in a multi-million dollar project to provide the City of Northglenn with its own water and wastewater utility systems. Since its incorporation in 1969, Northglenn has received utility services from the neighboring cities of Thornton and, to a lesser degree, Westminster. Under the Northglenn Water Management Plan, Northglenn will commence operation of its systems and Thornton will cease supplying water and providing wastewater treatment to Northglenn. No injury will result to the owners or persons entitled to use water under vested water rights or decreed conditional water rights as a result of this discontinuation of service by Thornton, because both water and wastewater service to Northglenn will be terminated at the same time, thereby reducing the demand of the Thornton utility systems on the South Platte River system.

A central element of the Northglenn project is this Plan for Augmentation. By contract dated September 2, 1976, Northglenn and the Farmers Reservoir and Irrigation Company (FRICO) have agreed that Northglenn shall have the right to make use of up to 7,785 acre feet of water per year owned by FRICO and stored in Standley Lake Reservoir. Under this contract, Northglenn will deliver this water by pipeline to a newly constructed water treatment plant, treat and distribute the water to all municipal customers located within the city. Wastewater from all of the customers will remain under Northglenn's control, and will be collected and conveyed to a central location from which it will be pumped to a wastewater treatment plant to be constructed in Weld County. In order to comply with the Federal Clean Water Act, Northglenn will also maintain dominion and control over irrigation return flows and urban storm runoff emanating from the city, and pump them to the same wastewater treatment plant. The treated wastewater will be stored in a reservoir to be constructed at the treatment plant site in Weld County, and eventually discharged into the Bull Canal, from which it will be distributed by FRICO for use in irrigation of the lands historically irrigated under the Standley Lake Division of FRICO.

By the terms of the contract, Northglenn is obligated to provide to FRICO, by discharge from the wastewater reservoir, 110% of the water diverted by Northglenn from Standley Lake pursuant to said agreement. The water to be so provided to FRICO will be supplied from municipal wastewater, Clear Creek, groundwater tributary to the South Platte River, municipal irrigation return flows and urban runoff tributary to the South Platte River, and groundwater from the non-tributary Arapahoe and Laramie-Fox Hills Aquifers.

(b) Out-of-Priority Diversions.

In order for the Project to operate as described above, Applicant will divert up to 2,006 acre feet of water out of the South Platte River in a dry year through one or more of the facilities set forth in paragraph 2. Approximately 1,400 acre feet per year may come out from Grange Hall Creek at the Irma Drive Diversion Structure, and up to 1,500 acre feet per year may come from the South Platte alluvium at the South Platte Wells No. 1-5, for use in the Northglenn water and sewer utility systems. Some of these diversions will be made when these structures are not in priority.

In wet to average years Northglenn will not need to divert the entire 2,006 acre feet quantity of water. At such times and to the quantity not needed by Northglenn, the City will, in compliance with contractual obligations and municipal regulations, dispose of this water on an as available basis.

Northglenn has applied for 2,300 acre feet of water from non-tributary deep wells in case number W-8445. Northglenn will drill, equip and pump those wells to the extent of water decreed in that case. For each acre foot of water pumped from those deep wells Northglenn can reduce its out-of-priority diversions from the water rights set forth in paragraph 2 supra for its own uses within the Plan. In such event the augmented out-of-priority diversions from the water rights set forth in paragraph 2, supra, will be used by Northglenn pursuant to contractual and municipal obligations for irrigation, municipal, domestic and all other beneficial uses at such places as the City elects.

(c) Replacement of Out-of-Priority Diversions.

Applicant will replace water in the South Platte River from the Augmention Water Rights set forth in paragraph 3, supra, at the proper time, place and rate, to replace that portion of the 2,006 acre feet of water diverted out-of-priority, thereby preventing injury to other water rights.

Preliminary engineering studies indicate that the City's present ownership of augmenting water rights will yield the following amounts of water, on a consumptive use basis, in the dry year:

Fulton Ditch	199	acre feet
Lupton Bottom Ditch	466	
Brantner Ditch	110	
Burlington-Wellington	951	
Lower Clear Creek	169	
Reithmann Ditch	111	
	2,006	

(d) Operation of Plan

Applicant will divert the 2,006 acre feet of water at the facilities set forth in paragraph 2, supra, only when the augmentation water (paragraph 3) is available in priority at the original point of diversion and to the extent that the water would then be applied to a beneficial consumptive use under the historic conditions and water would in fact be consumed.

To determine these factors Applicant proposes to install Augmentation stations for each Augmentation water right set forth in paragraph 3 hereof. The Augmentation station will consist of: (1) a method acceptable to the Division Engineer for carriage of the consumptive use occurring upon the original tract of land back to the South Platte River and (2) a method acceptable to the Division Engineer for determining the actual consumption then occurring on the original tract under the historic practices.

By this practice Applicant will maintain the historic patterns of return flow, as well as its pro rata share of historic ditch losses. In addition, because Applicant will only be diverting at its structures set forth in paragraph 2, supra, that amount of water that would have historically been consumed under the historic use practices no other water users will be injured.

After such sufficient period of operation as to Applicant or the Division Engineer evidences the appropriate river gage index to govern the operation of this plan, Applicant will petition this Court pursuant to its continuing jurisdiction to modify this decree consistent with such additional operational evidence.

WHEREFORE, Applicant prays the Court enter its decree:

1. Finding that no injury will occur to other water uses and approving the Plan for Augmentation set forth herein.

2. Finding that unappropriated water is available for withdrawal by Applicant's South Platte Wells Nos. 1-5 and that their operation will not cause material injury to vested water rights or decreed conditional water rights if said wells are operated in accordance with this Plan for Augmentation.

3. Permitting Applicant to divert water under the water rights listed in paragraph 2, supra, when said rights are out-of-priority, in accordance with this Plan for Augmentation.

4. Permitting the use of the water rights listed in paragraph 3, supra, for all beneficial purposes including domestic, municipal, industrial, commercial, irrigation, augmentation and exchange, at any location and manner set forth in this plan for augmentation, as alternate points and purposes of use.

5. Permitting Applicant to use the augmentation water set forth in paragraph 3, supra for all beneficial purposes at any place capable of being served by the facilities set forth in paragraph 2 supra, to the extent that the water is not needed within Northglenn of the water decreed as non-tributary in W-8445 is used within Northglenn for the purposes of its Project.

6. Affording such other relief as the Court deems proper.

Dated this 31st day of August, 1979.

MUSICK, WILLIAMSON, SCHWARTZ,
LEAVENWORTH & COPE, P.C.

By John D. Musick
John D. Musick, Jr. (6341)

By
Joseph A. Cope (7633)

Post Office Box 4579
Boulder, Colorado 80306
(303) 499-3990

Special Counsel to Applicant
The City of Northglenn, Colorado

STATE OF COLORADO)
) ss.
COUNTY OF ADAMS)

Richard P. Lundahl, being first duly sworn upon oath, deposes and says that he is the Director of Natural Resources for the City of Northglenn, that he has read the foregoing Application for Approval of Plan for Augmentation, knows the contents thereof, and that the same are true to the best of his knowledge and belief.

Richard P. Lundahl
Richard P. Lundahl

Subscribed and sworn to before me this 31st day of August, 1979.

Notary Public

My commission expires: DECEMBER 13, 1981

APPENDIX D-6

Pending Litigation Concerning the City of Northglenn's Water Management Project, (as of September 13, 1979):

Water Supply - Deep Well

Colorado law requires a permit from the State Engineer to construct wells and withdraw ground water, and the Colorado State Engineer has denied permits for the deep wells proposed by the Northglenn Plan. The City is presently appealing this denial, and seeking permission of the Water Court to withdraw this water. A hearing in the case was held in December, 1978, and the Water Referee's decision is expected shortly. Unrelated litigation (generally referred to as the "Houston Case") is pending before a special Colorado water judge questioning the validity of legislation governing the withdrawal of deep well water and may be of interest. This litigation may not affect the outcome of the City's deep well applications, because the challengers are seeking to have declared invalid limitations which the city has voluntarily adhered to.

Water Rights Acquisition.

The cities of Thornton, Westminster, Golden and Broomfield filed legal actions against the City of Northglenn and FRICO concerning the purchase of the Church Ditch and Berthoud Pass water rights by the City from FRICO. The dismissal of the Westminster and Thornton proceedings has been obtained as a condition of the acquisition of the Thornton systems by the City. The Broomfield case has been dismissed twice by the court, and further proceedings are being held in abeyance during discussions between Northglenn and Broomfield. The Golden case is also being held in abeyance at the present time by agreement of the parties.

Water Court Approval.

Under Colorado law, existing water rights may be used in a different manner than has been the historical case, with prior permission of the Water Court to ensure that replacement water is adequate to protect other water users. The replacement water supplies, including deep wells and purchased water rights, have been identified, and the application for court approval was filed on August 31, 1979. Discussions with the potential objectors have commenced.

Miscellaneous Water Court Matters.

The City is a party in numerous Colorado Water Court proceedings concerning the manner, purpose and place of use, as well as the magnitude and priority, of water rights of the city and other water users. These matters should not present a significant threat to the City's water rights as those matters now stand.

FRICO Agreements.

The City, together with Thornton and Westminster, has intervened in an action brought by a FRICO shareholder, Rocky Mountain Fuel Company, against FRICO challenging the 1976 Northglenn-FRICO Agreement, the "4-way" Agreement among FRICO and the three cities, and a sale of the Church Ditch water rights to the city. The case questions the power of the FRICO Board of Directors to approve these agreements without the approval of specified majorities of the shareholders. The plaintiff has been denied a temporary restraining order and has now moved to further amend the complaint in this case.

Weld County Zoning Authority

Under Colorado law, counties are responsible for zoning of unincorporated land, which includes the wastewater treatment plant site in southern Weld County. Weld County has zoned the site for uses which do not include wastewater treatment plants unless a special use permit has been issued. Concern has been expressed that the denial of a permit by the Board of County Commissioners of Weld County, and a related lawsuit, will impair the city's ability to implement the plan in the manner or at the time desired. The City of Northglenn is of the opinion that county zoning such as is involved in this case does not apply to a public agency under Colorado law and that the city has fully complied with all applicable requirements for location of the plant at the Weld County site. Accordingly, a motion to dismiss the case has been filed by the City. Irrespective of the resolution of this case, EPA requires these two parties to execute an Intergovernmental Agreement to specify their respective responsibilities in this matter.

Water Quality Control Commission

The City of Northglenn has been joined as a defendant in two separate actions filed against the Colorado Water Quality Control Commission concerning the commission's approval of the city's wastewater treatment plant site, plans and specifications, and federal construction grant. These actions have been filed by residents of the vicinity of the site, the Towns of Frederick and Fort Lupton, the Board of County Commissioners of Weld County, and an organization representing several irrigation ditches. A motion to dismiss one of the cases heard on October 16, 1979.

Grand Jury Investigation

In August 1979, the State Grand Jury's Office of the Special Organized Crime Task Force subpoened certain records of the City of Northglenn regarding the Water Resources Management Plan. This is a secret investigation consequently the intent, interests, or areas of investigation of the Grand Jury are not publicly disclosed.

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NORTHGLENN SPECIAL RESERVE FILE

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CONVERSION TABLE

Cubic feet per second x 498.831 = Gallons per minute

Cubic feet per second x 0.646317 = Million gallons per day

Acre-feet x 43,560 = cubic feet

Acre-feet x 325,851 = Gallons

Cubic feet x 7.48052 = Gallons

Feet x 30.48 = Centimeters

Feet x 0.3048 = Meters

Gallons x 0.1337 = Cubic feet

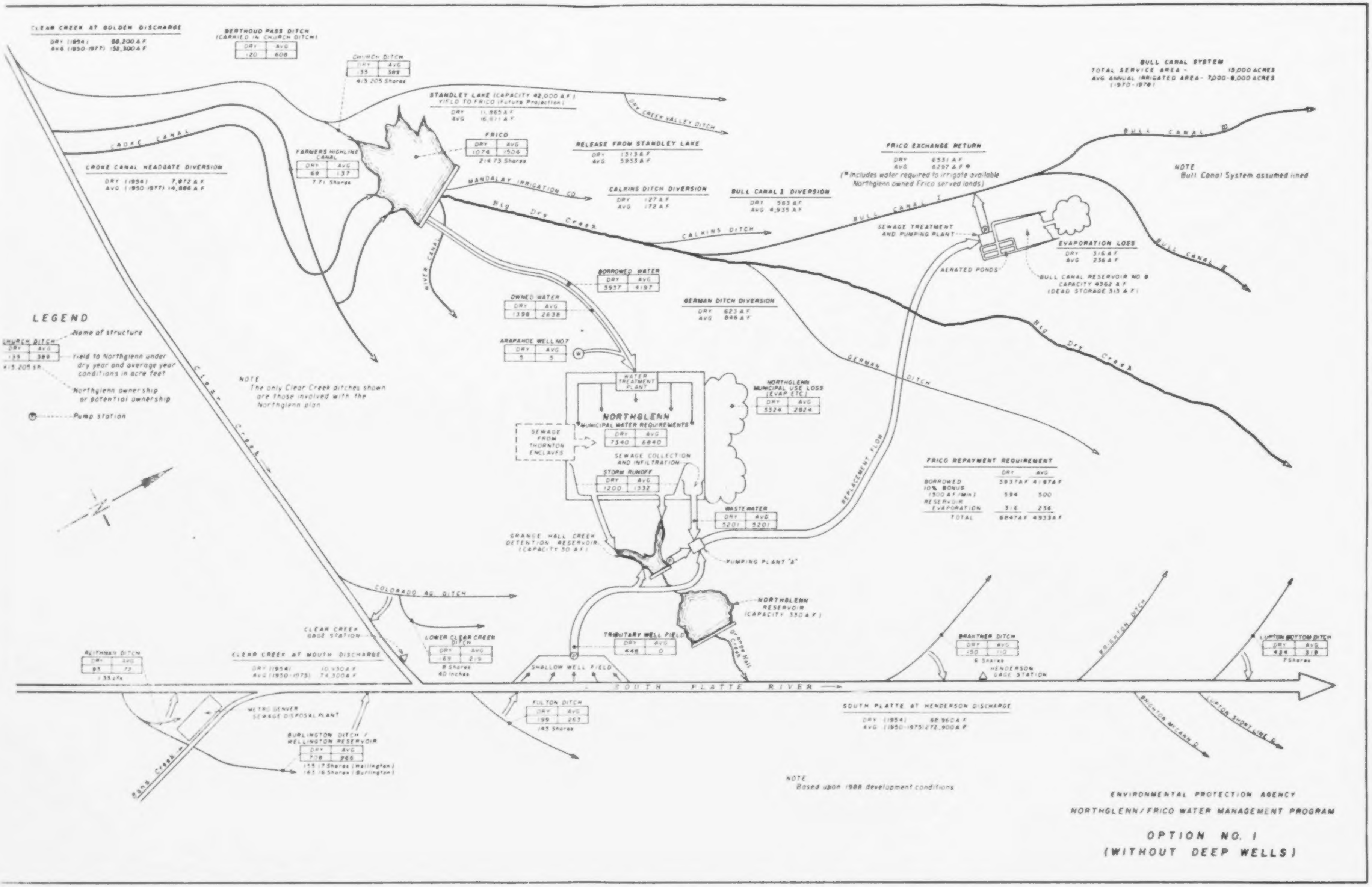
Gallons per minute x 2.228×10^{-3} = Cubic feet per second

Hectares x 2.471 = Acres

Liters x 0.03531 = Cubic feet

Liters x 0.2642 = Gallons

FIGURE 3-2

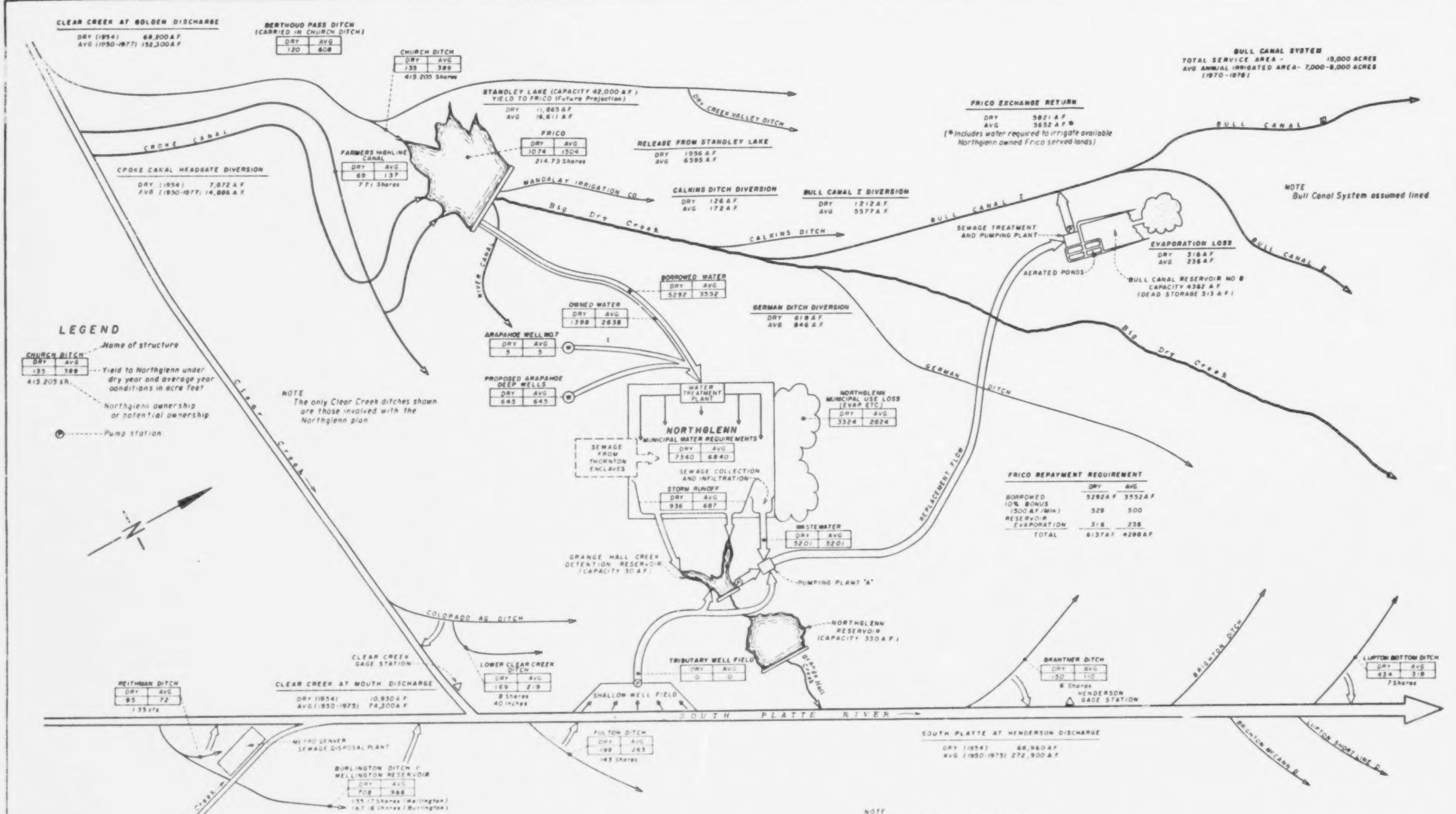

CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A F
AVG (1950-1977) 152,300 A F
BERTHOUD PASS DITCH (CARRIED IN CHURCH DITCH)
DRY 120 AVG 608
CHURCH DITCH
DRY 135 AVG 389
4/5 205 Shares
STANDLEY LAKE (CAPACITY 42,000 A F)
YIELD TO FRICO (Future Projection)
DRY 11,865 A F
AVG 16,911 A F
FRICO
DRY 1074 AVG 1504
214 73 Shares
FARMERS HIGHLINE CANAL
DRY 69 AVG 137
7.71 Shares
CROKE CANAL
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A F
AVG (1950-1977) 14,886 A F
DRY CREEK VALLEY DITCH
RELEASE FROM STANDLEY LAKE
DRY 1313 A F
AVG 5953 A F
MANDALAY IRRIGATION CO
Big Dry Creek
CALKINS DITCH DIVERSION
DRY 127 A F
AVG 172 A F
CALKINS DITCH
BULL CANAL I DIVERSION
DRY 563 A F
AVG 4,935 A F
BULL CANAL I
RIVER CANAL
BORROWED WATER
DRY 5937 AVG 4197
OWNED WATER
DRY 1398 AVG 2638
ARAPAHOE WELL NO 7
DRY 5 AVG 5
GERMAN DITCH DIVERSION
DRY 623 A F
AVG 846 A F
GERMAN DITCH
FRICO EXCHANGE RETURN
DRY 6531 A F
AVG 6297 A F *
(* Includes water required to irrigate available Northglenn owned Frico served lands)
BULL CANAL SYSTEM
TOTAL SERVICE AREA - 15,000 ACRES
AVG ANNUAL IRRIGATED AREA - 7,000-8,000 ACRES (1970-1978)
BULL CANAL III
BULL CANAL II
NOTE
Bull Canal System assumed lined
SEWAGE TREATMENT AND PUMPING PLANT
AERATED PONDS
EVAPORATION LOSS
DRY 316 A F
AVG 236 A F
BULL CANAL RESERVOIR NO 8
CAPACITY 4362 A F
(DEAD STORAGE 313 A F)
LEGEND
CHURCH DITCH
DRY 135 AVG 389
4/5 205 sh.
Name of structure
Yield to Northglenn under dry year and average year conditions in acre feet
Northglenn ownership or potential ownership
Pump station
NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan
Clear Creek
WATER TREATMENT PLANT
NORTHGLENN
MUNICIPAL WATER REQUIREMENTS
DRY 7340 AVG 6840
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECTION AND INFILTRATION
STORM RUNOFF
DRY 1200 AVG 1332
NORTHGLENN MUNICIPAL USE LOSS (EVAP ETC)
DRY 3324 AVG 2824
WASTEWATER
DRY 5201 AVG 5201
REPLACEMENT FLOW
FRICO REPAYMENT REQUIREMENT
DRY AVG
BORROWED 5937 A F 4197 A F
10% BONUS (500 A F/Min) 594 500
RESERVOIR EVAPORATION 316 236
TOTAL 6847 A F 4933 A F
GRANGE HALL CREEK DETENTION RESERVOIR (CAPACITY 30 A F)
PUMPING PLANT "A"
NORTHGLENN RESERVOIR (CAPACITY 330 A F)
Grange Hall Creek
TRIBUTARY WELL FIELD
DRY 446 AVG 0
SHALLOW WELL FIELD
COLORADO AG. DITCH
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
DRY 169 AVG 219
8 Shares
40 Inches
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A F
AVG (1950-1975) 74,300 A F
REITHMAN DITCH
DRY 95 AVG 72
1.35 cfs
METRO DENVER SEWAGE DISPOSAL PLANT
Sand Creek
BURLINGTON DITCH / WELLINGTON RESERVOIR
DRY 708 AVG 966
155 17 Shares (Wellington)
163 16 Shares (Burlington)
FULTON DITCH
DRY 199 AVG 263
145 Shares
SOUTH PLATTE RIVER
BRANTNER DITCH
DRY 150 AVG 110
6 Shares
HENDERSON GAGE STATION
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY 424 AVG 319
7 Shares
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A F
AVG (1950-1975) 272,900 A F
BRIGHTON McCANN D.
LUPTON SHORT LINE D.
NOTE
Based upon 1988 development conditions
N

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 1
(WITHOUT DEEP WELLS)

FIGURE 3-3

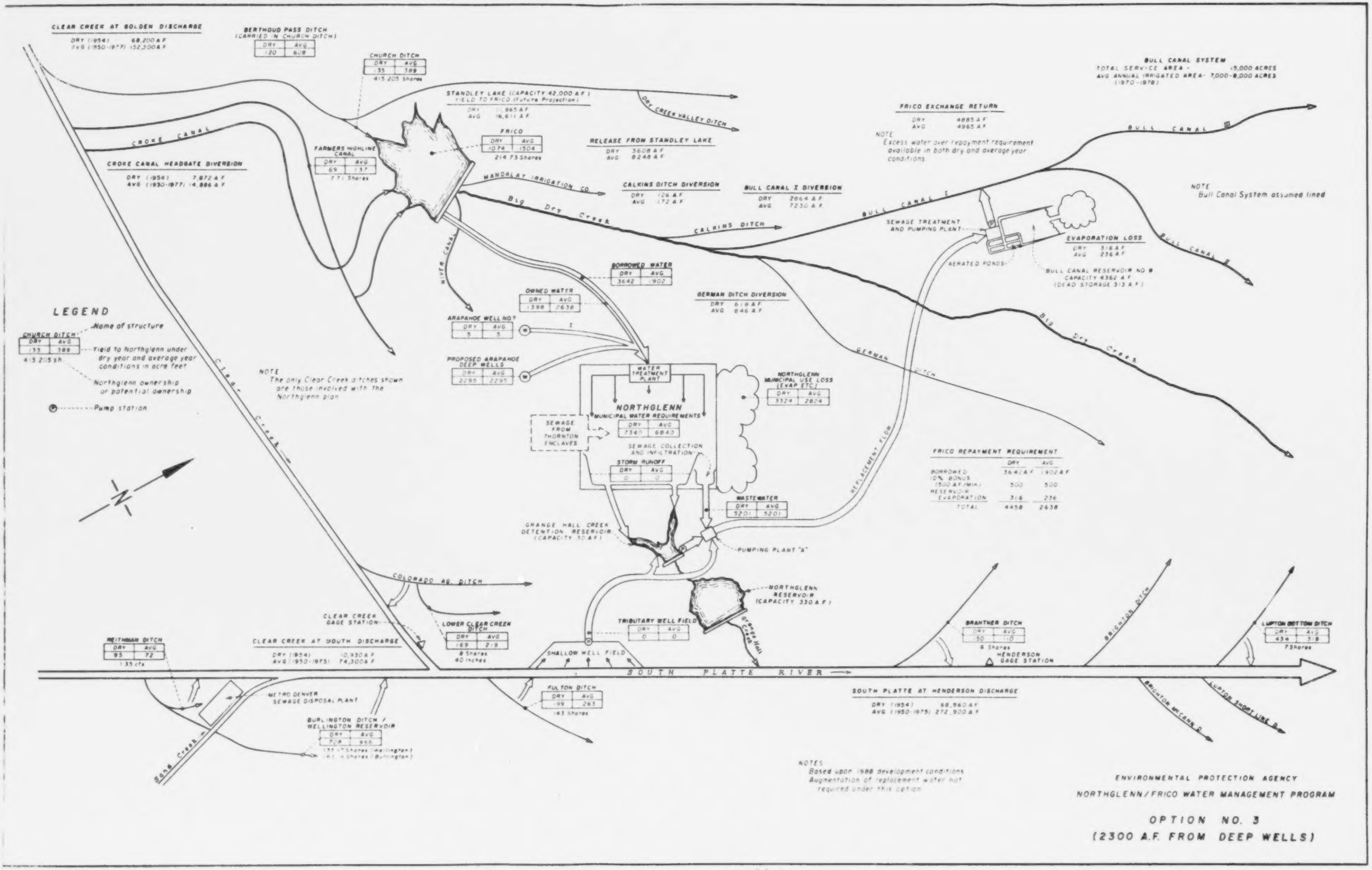

CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A F
AVG (1950-1977) 152,300 A F
BERTHOUD PASS DITCH (CARRIED IN CHURCH DITCH)
DRY AVG
120 608
CHURCH DITCH
DRY AVG
135 389
415.205 Shares
STANDLEY LAKE (CAPACITY 42,000 A F) YIELD TO FRICO (Future Projection)
DRY 11,865 A F
AVG 16,611 A F
DRY CREEK VALLEY DITCH
CROKE CANAL
FARMERS HIGHLINE CANAL
DRY AVG
69 137
7.71 Shares
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A F
AVG (1950-1977) 14,886 A F
FRICO
DRY AVG
1074 1504
214.73 Shares
RELEASE FROM STANDLEY LAKE
DRY 1956 A F
AVG 6595 A F
MANDALAY IRRIGATION CO.
CALKINS DITCH DIVERSION
DRY 126 A F
AVG 172 A F
BULL CANAL I DIVERSION
DRY 1212 A F
AVG 5577 A F
Big Dry Creek
CALKINS DITCH
BULL CANAL SYSTEM
TOTAL SERVICE AREA - 15,000 ACRES
AVG ANNUAL IRRIGATED AREA - 7,000-8,000 ACRES (1970-1976)
FRICO EXCHANGE RETURN
DRY 5821 A F
AVG 5652 A F *
(* Includes water required to irrigate available Northglenn owned Frico served lands)
BULL CANAL
BULL CANAL I
NOTE
Bull Canal System assumed lined
SEWAGE TREATMENT AND PUMPING PLANT
EVAPORATION LOSS
DRY 316 A F
AVG 236 A F
AERATED PONDS
BULL CANAL RESERVOIR NO 8
CAPACITY 4362 A F
(DEAD STORAGE 313 A F)
BULL CANAL II
RIVER CANAL
BORROWED WATER
DRY AVG
5292 3552
OWNED WATER
DRY AVG
1398 2638
GERMAN DITCH DIVERSION
DRY 618 A F
AVG 846 A F
GERMAN DITCH
ARAPAHOE WELL NO. 7
DRY AVG
5 5
PROPOSED ARAPAHOE DEEP WELLS
DRY AVG
645 645
LEGEND
CHURCH DITCH
DRY AVG
135 389
415.205 sh.
Name of structure
Yield to Northglenn under dry year and average year conditions in acre feet
Northglenn ownership or potential ownership
Pump station
N
Clear Creek
NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan
WATER TREATMENT PLANT
NORTHGLENN
MUNICIPAL WATER REQUIREMENTS
DRY AVG
7340 6840
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECTION AND INFILTRATION
STORM RUNOFF
DRY AVG
936 687
NORTHGLENN MUNICIPAL USE LOSS (EVAP ETC)
DRY AVG
3324 2824
REPLACEMENT FLOW
WASTEWATER
DRY AVG
5201 5201
FRICO REPAYMENT REQUIREMENT
DRY AVG
BORROWED 5292 A F 3552 A F
10% BONUS (500 A F/Min) 529 500
RESERVOIR EVAPORATION 316 236
TOTAL 6137 A F 4288 A F
GRANGE HALL CREEK DETENTION RESERVOIR (CAPACITY 30 A F)
PUMPING PLANT "A"
NORTHGLENN RESERVOIR (CAPACITY 330 A F)
Grange Hall Creek
COLORADO AG. DITCH
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
DRY AVG
169 219
8 Shares
40 Inches
TRIBUTARY WELL FIELD
DRY AVG
0 0
SHALLOW WELL FIELD
REITHMAN DITCH
DRY AVG
95 72
1.35 cfs
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A F
AVG (1950-1975) 74,300 A F
SOUTH PLATTE RIVER
METRO DENVER SEWAGE DISPOSAL PLANT
Sand Creek
BURLINGTON DITCH / WELLINGTON RESERVOIR
DRY AVG
708 966
135.17 Shares (Wellington)
167.16 Shares (Burlington)
FULTON DITCH
DRY AVG
199 263
143 Shares
BRANTNER DITCH
DRY AVG
150 110
6 Shares
HENDERSON GAGE STATION
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY AVG
434 319
7 Shares
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A F
AVG (1950-1975) 272,900 A F
BRIGHTON McCANN D.
LUPTON SHORT LINE D.
NOTE
Based upon 1988 development conditions

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 2
(650 A.F. FROM DEEP WELLS)

FIGURE 3-4


Clear Creek
CROKE CANAL
DRY CREEK VALLEY DITCH
MANDALAY IRRIGATION CO.
Big Dry Creek
CALKINS DITCH
BULL CANAL I
BULL CANAL II
BULL CANAL III
RIVER CANAL
GERMAN DITCH
REPLACEMENT FLOW
SEWAGE TREATMENT AND PUMPING PLANT
AERATED PONDS
BULL CANAL RESERVOIR NO 8 CAPACITY 4362 A F (DEAD STORAGE 313 A F)
WATER TREATMENT PLANT
NORTHGLENN
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECTION AND INFILTRATION
GRANGE HALL CREEK DETENTION RESERVOIR (CAPACITY 30 A F)
PUMPING PLANT "A"
NORTHGLENN RESERVOIR (CAPACITY 330 A F)
Grange Hall Creek
SHALLOW WELL FIELD
COLORADO AG. DITCH
CLEAR CREEK GAGE STATION
METRO DENVER SEWAGE DISPOSAL PLANT
Sand Creek
SOUTH PLATTE RIVER
HENDERSON GAGE STATION
BRIGHTON DITCH
BRIGHTON McCANN D.
LUPTON SHORT LINE D.
N

LEGEND

CHURCH DITCH	
DRY	AVG
135	389

415.205 sh.

- Name of structure
- Yield to Northglenn under dry year and average year conditions in acre feet
- Northglenn ownership or potential ownership
- Pump station

NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan

CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A F
AVG (1950-1977) 132,300 A F

CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A F
AVG (1950-1977) 14,886 A F

BERTHOUD PASS DITCH (CARRIED IN CHURCH DITCH)

DRY	AVG
120	608

CHURCH DITCH

DRY	AVG
135	389

415.205 Shares

FARMERS HIGHLINE CANAL

DRY	AVG
69	137

7.71 Shares

STANDLEY LAKE (CAPACITY 42,000 A F) YIELD TO FRICO (Future Projection)
DRY 11,865 A F
AVG 16,611 A F

FRICO

DRY	AVG
1074	1504

214.73 Shares

RELEASE FROM STANDLEY LAKE
DRY 3608 A F
AVG 8248 A F

CALKINS DITCH DIVERSION
DRY 126 A F
AVG 172 A F

BULL CANAL I DIVERSION
DRY 2864 A F
AVG 7230 A F

FRICO EXCHANGE RETURN
DRY 4885 A F
AVG 4965 A F

NOTE
Excess water over repayment requirement available in both dry and average year conditions

BULL CANAL SYSTEM
TOTAL SERVICE AREA - 15,000 ACRES
AVG ANNUAL IRRIGATED AREA - 7,000-8,000 ACRES (1970-1978)

NOTE
Bull Canal System assumed lined

EVAPORATION LOSS
DRY 316 A F
AVG 236 A F

BORROWED WATER

DRY	AVG
3642	1902

OWNED WATER

DRY	AVG
1398	2638

ARAPAHOE WELL NO.?

DRY	AVG
5	5

PROPOSED ARAPAHOE DEEP WELLS

DRY	AVG
2295	2295

GERMAN DITCH DIVERSION
DRY 618 A F
AVG 846 A F

NORTHGLENN MUNICIPAL WATER REQUIREMENTS

DRY	AVG
7340	6840

NORTHGLENN MUNICIPAL USE LOSS (EVAP ETC.)

DRY	AVG
3324	2824

STORM RUNOFF

DRY	AVG
0	0

WASTEWATER

DRY	AVG
5201	5201

FRICO REPAYMENT REQUIREMENT

	DRY	AVG
BORROWED	3642 A F	1902 A F
10% BONUS (500 A F MIN.)	500	500
RESERVOIR EVAPORATION	316	236
TOTAL	4458	2638

TRIBUTARY WELL FIELD

DRY	AVG
0	0

LOWER CLEAR CREEK DITCH

DRY	AVG
169	219

8 Shares
40 Inches

CLEAR CREEK AT SOUTH DISCHARGE
DRY (1954) 10,930 A F
AVG (1950-1975) 74,300 A F

REITHMAN DITCH

DRY	AVG
95	72

1.35 cfs

BURLINGTON DITCH / WELLINGTON RESERVOIR

DRY	AVG
708	966

135.17 Shares (Wellington)
161.11 Shares (Burlington)

FULTON DITCH

DRY	AVG
199	263

143 Shares

BRANTNER DITCH

DRY	AVG
50	110

6 Shares

LUPTON BOTTOM DITCH

DRY	AVG
434	319

7 Shares

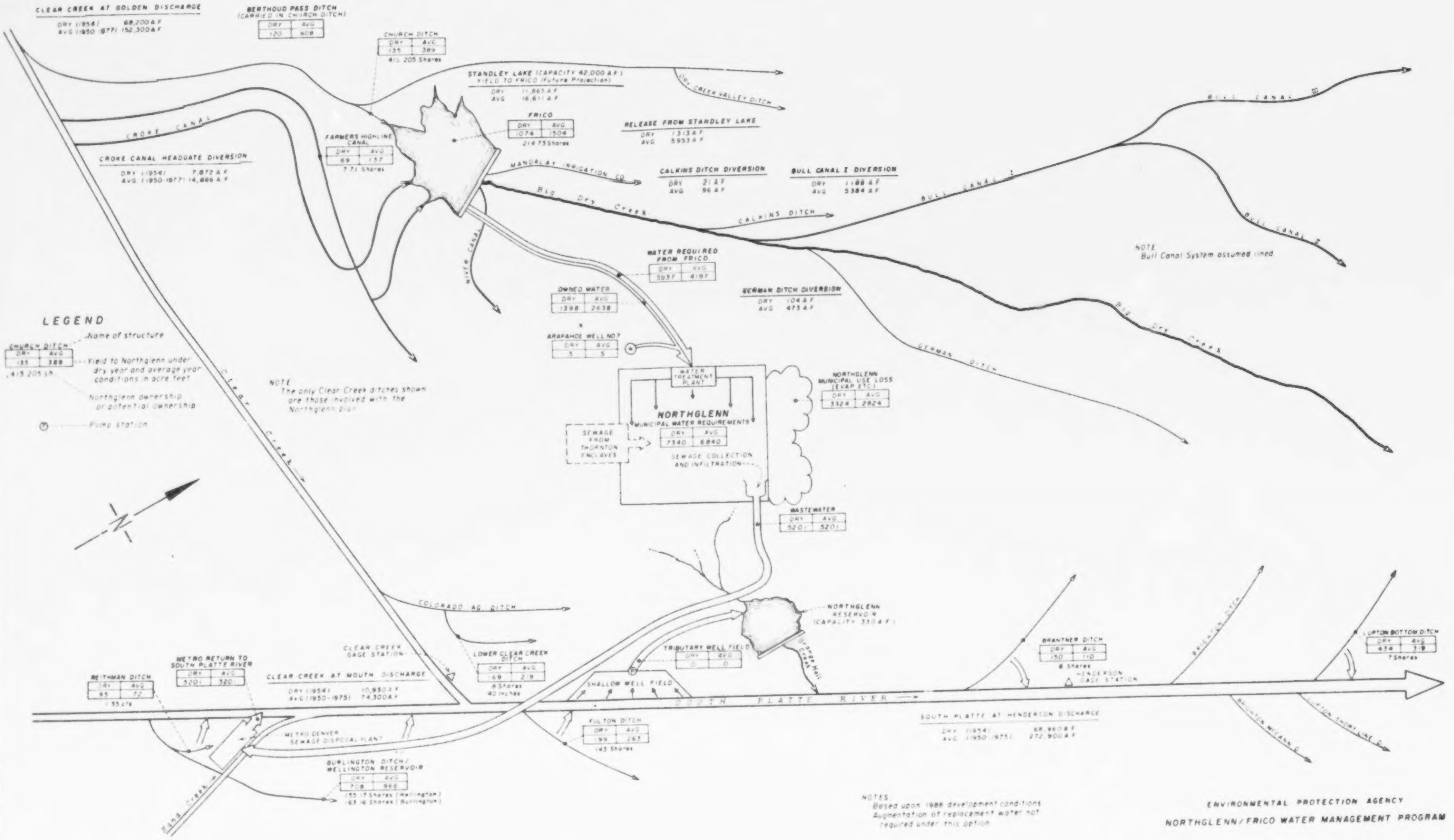
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A F
AVG (1950-1975) 272,900 A F

NOTES
Based upon 1988 development conditions
Augmentation of replacement water not required under this option

ENVIRONMENTAL PROTECTION AGENCY
NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 3
(2300 A.F. FROM DEEP WELLS)

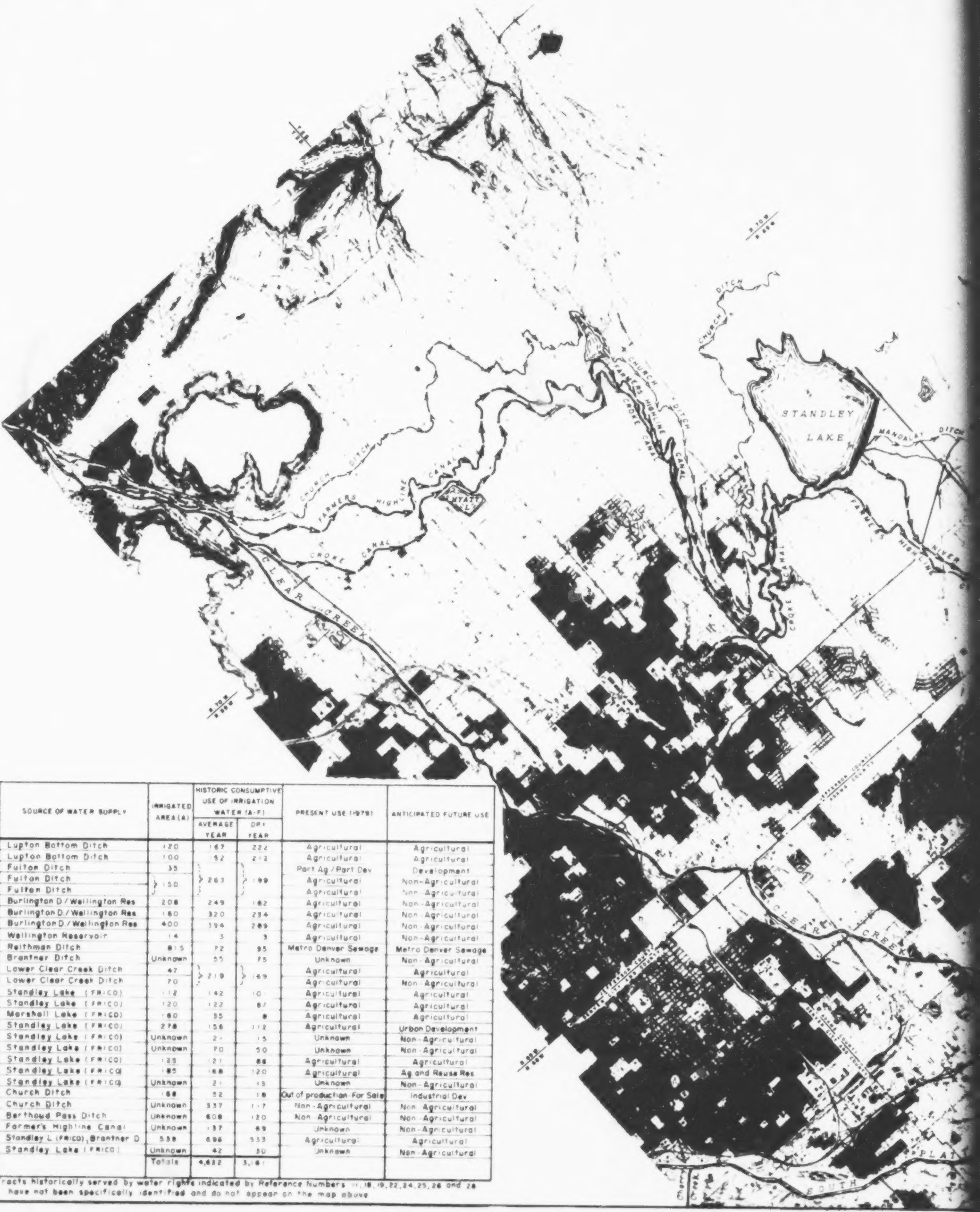
FIGURE 3-5


CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A F
AVG (1950-1977) 152,300 A F
BERTHOUD PASS DITCH (CARRIED IN CHURCH DITCH)
DRY 120 AVG 608
CHURCH DITCH
DRY 135 AVG 389
41½ 205 Shares
STANDLEY LAKE (CAPACITY 42,000 A F) YIELD TO FRICO (Future Projection)
DRY 11,865 A F
AVG 16,611 A F
FRICO
DRY 1074 AVG 1504
214 735 Shares
RELEASE FROM STANDLEY LAKE
DRY 1313 A F
AVG 5953 A F
DRY CREEK VALLEY DITCH
CROKE CANAL
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A F
AVG (1950-1977) 14,886 A F
FARMERS HIGHLINE CANAL
DRY 69 AVG 137
7.71 Shares
MANDALAY IRRIGATION CO
CALKINS DITCH DIVERSION
DRY 21 A F
AVG 96 A F
BULL CANAL I DIVERSION
DRY 1188 A F
AVG 5384 A F
BULL CANAL III
BULL CANAL I
BULL CANAL II
Big Dry Creek
CALKINS DITCH
NOTE
Bull Canal System assumed lined.
NIVER CANAL
WATER REQUIRED FROM FRICO
DRY 5937 AVG 4197
OWNED WATER
DRY 1398 AVG 2638
GERMAN DITCH DIVERSION
DRY 104 A F
AVG 473 A F
GERMAN DITCH
ARAPAHOE WELL NO 7
DRY 5 AVG 5
LEGEND
CHURCH DITCH
DRY 135 AVG 389
415 205 sh.
Name of structure
Yield to Northglenn under dry year and average year conditions in acre feet
Northglenn ownership or potential ownership
Pump station
NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan
Clear Creek
N
WATER TREATMENT PLANT
NORTHGLENN
MUNICIPAL WATER REQUIREMENTS
DRY 7340 AVG 6840
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECTION AND INFILTRATION
NORTHGLENN MUNICIPAL USE LOSS (EVAP ETC.)
DRY 3324 AVG 2824
WASTEWATER
DRY 5201 AVG 5201
COLORADO AG. DITCH
NORTHGLENN RESERVOIR (CAPACITY 330 A F)
Grange Hall Creek
TRIBUTARY WELL FIELD
DRY 0 AVG 0
SHALLOW WELL FIELD
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
DRY 169 AVG 219
8 Shares
40 Inches
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A F
AVG (1950-1975) 74,300 A F
REITHMAN DITCH
DRY 95 AVG 72
1.35 cfs
METRO RETURN TO SOUTH PLATTE RIVER
DRY 5201 AVG 5201
METRO DENVER SEWAGE DISPOSAL PLANT
BURLINGTON DITCH / WELLINGTON RESERVOIR
DRY 708 AVG 966
155.17 Shares (Wellington)
163.16 Shares (Burlington)
Sand Creek
FULTON DITCH
DRY 199 AVG 263
143 Shares
SOUTH PLATTE RIVER
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A F
AVG (1950-1975) 272,900 A F
BRANTNER DITCH
DRY 150 AVG 110
8 Shares
HENDERSON GAGE STATION
BRIGHTON DITCH
BRIGHTON McCANN D.
LUPTON BOTTOM DITCH
DRY 434 AVG 319
7 Shares
LUPTON SHORTLINE D.

NOTES:
Based upon 1988 development conditions
Augmentation of replacement water not required under this option

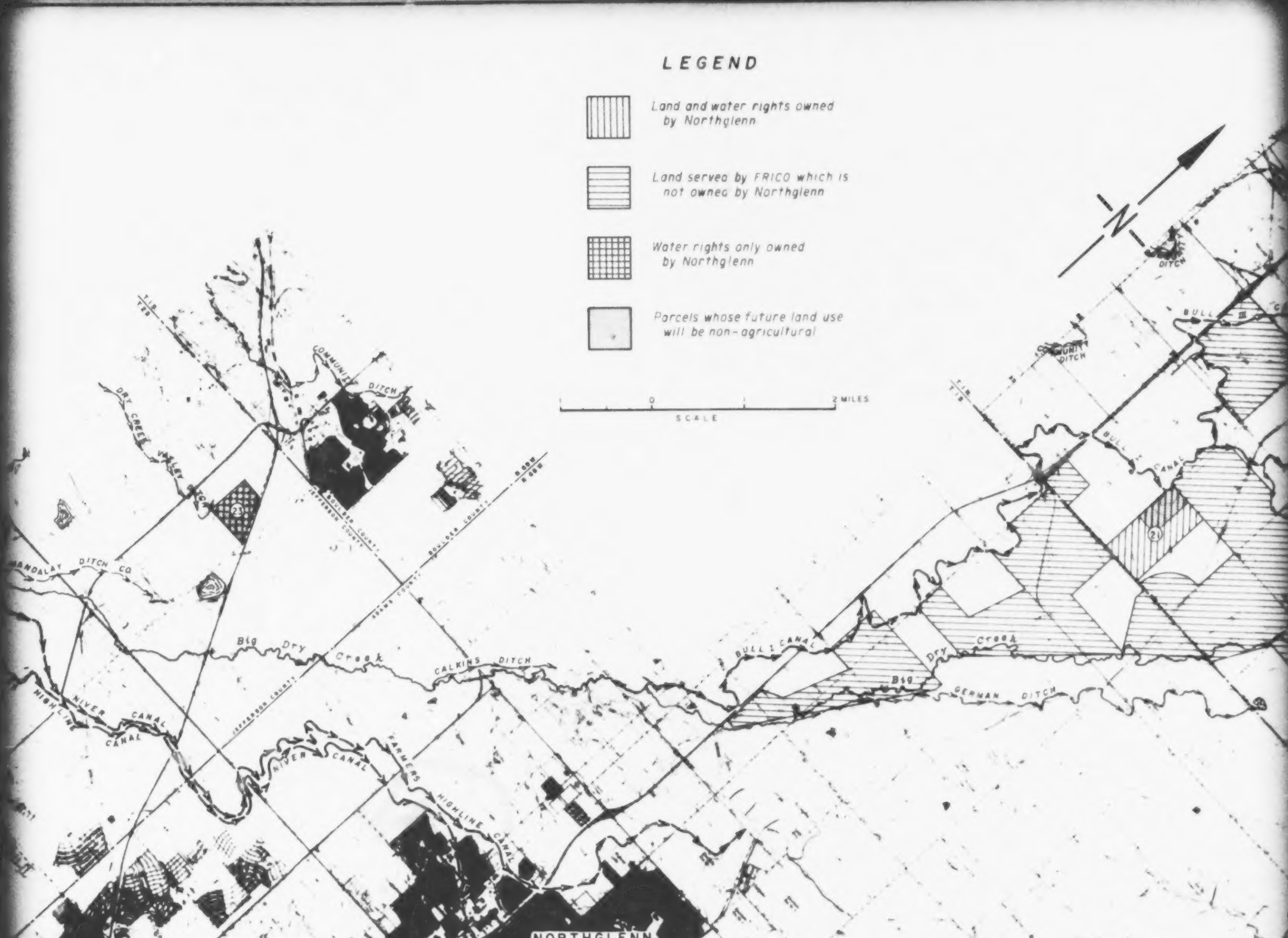
ENVIRONMENTAL PROTECTION AGENCY
NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 4
(RETURN TO METRO)



REFERENCE NO.	SOURCE OF WATER SUPPLY	IRRIGATED AREA (A)	HISTORIC CONSUMPTIVE USE OF IRRIGATION WATER (A-F)		PRESENT USE (1979)	ANTICIPATED FUTURE USE
			AVERAGE YEAR	DRY YEAR		
1	Lupton Bottom Ditch	120	167	222	Agricultural	Agricultural
2	Lupton Bottom Ditch	100	152	212	Agricultural	Agricultural
3	Fulton Ditch	35	263	199	Part Ag / Part Dev	Development
4	Fulton Ditch	150			Agricultural	Non-Agricultural
5	Fulton Ditch				Agricultural	Non-Agricultural
6	Burlington D / Wellington Res	208	249	182	Agricultural	Non-Agricultural
7	Burlington D / Wellington Res	180	320	234	Agricultural	Non-Agricultural
8	Burlington D / Wellington Res	400	394	289	Agricultural	Non-Agricultural
9	Wellington Reservoir	14	3	3	Agricultural	Non-Agricultural
10	Reithman Ditch	815	72	95	Metro Denver Sewage	Metro Denver Sewage
11	Brantner Ditch	Unknown	55	75	Unknown	Non-Agricultural
12	Lower Clear Creek Ditch	47	219	169	Agricultural	Agricultural
13	Lower Clear Creek Ditch	70			Agricultural	Non-Agricultural
14	Standley Lake (FRICO)	112	142	101	Agricultural	Agricultural
15	Standley Lake (FRICO)	120	122	87	Agricultural	Agricultural
16	Marshall Lake (FRICO)	160	35	8	Agricultural	Agricultural
17	Standley Lake (FRICO)	278	156	112	Agricultural	Urban Development
18	Standley Lake (FRICO)	Unknown	21	15	Unknown	Non-Agricultural
19	Standley Lake (FRICO)	Unknown	70	50	Unknown	Non-Agricultural
20	Standley Lake (FRICO)	125	121	88	Agricultural	Agricultural
21	Standley Lake (FRICO)	185	168	120	Agricultural	Ag and Reuse Res
22	Standley Lake (FRICO)	Unknown	21	15	Unknown	Non-Agricultural
23	Church Ditch	168	52	18	Out of production-For Sale	Industrial Dev
24	Church Ditch	Unknown	337	117	Non-Agricultural	Non-Agricultural
25	Berthoud Pass Ditch	Unknown	608	120	Non-Agricultural	Non-Agricultural
26	Farmer's Highline Canal	Unknown	137	89	Unknown	Non-Agricultural
27	Standley L (FRICO), Brantner D	538	696	533	Agricultural	Agricultural
28	Standley Lake (FRICO)	Unknown	42	30	Unknown	Non-Agricultural
		Totals	4,622	3,161		

NOTE: Tracts historically served by water rights indicated by Reference Numbers 11, 18, 19, 22, 24, 25, 26 and 28 have not been specifically identified and do not appear on the map above


LEGEND
Land and water rights owned by Northglenn
Land served by FRICO which is not owned by Northglenn
Water rights only owned by Northglenn
Parcels whose future land use will be non-agricultural
N
0
2 MILES
SCALE
NORTHGLENN
COMMUNITY DITCH
DRY CREEK VALLEY DITCH
MANDALAY DITCH CO.
BOULDER COUNTY
JEFFERSON COUNTY
ADAMS COUNTY
Big Dry Creek
CALKINS DITCH
HIGHLINE CANAL
RIVER CANAL
FARMERS HIGHLINE CANAL
BULL I CANAL
BULL II CANAL
GERMAN DITCH
DITCH
Grange Hall Cr
COLORADO AGRICULTURAL CANAL
LOWER CLEAR CREEK CANAL
BRANTNER DITCH
SOUTH PLATTE RIVER
FULTON DITCH
BURLINGTON DITCH
PLATTE RIVER
Sand Creek
T1S
T2S
R68W
R67W
21
23
12
13
10
6

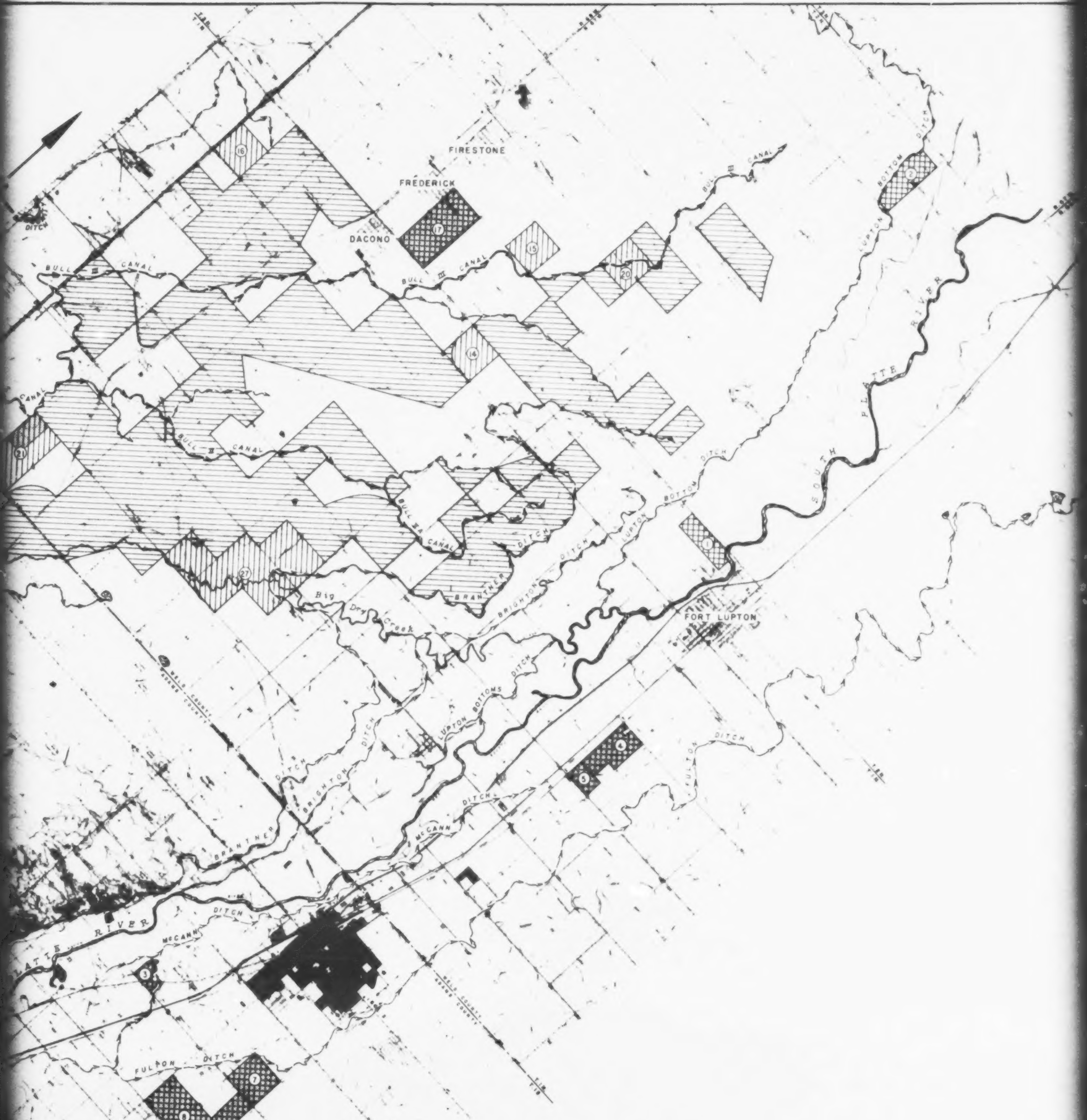

FIRESTONE
FREDERICK
DACONO
BULL III CANAL
BULL III CANAL
BULL III CANAL
BULL III CANAL
BULL IIIA CANAL
CANAL
DITCH
LUPTON BOTTOM DITCH
LUPTON BOTTOM DITCH
SOUTH PLATTE RIVER
FORT LUPTON
Big Dry Creek
BRANTNER DITCH
BRANTNER DITCH
BRIGHTON DITCH
BRIGHTON DITCH
LUPTON BOTTOMS DITCH
FULTON DITCH
FULTON DITCH
McCANN DITCH
McCANN DITCH
PLATTE RIVER
RIVER
WELD COUNTY
ADAMS COUNTY
WELD COUNTY
ADAMS COUNTY
1
2
3
4
5
7
8
9
14
15
16
17
20
21
27

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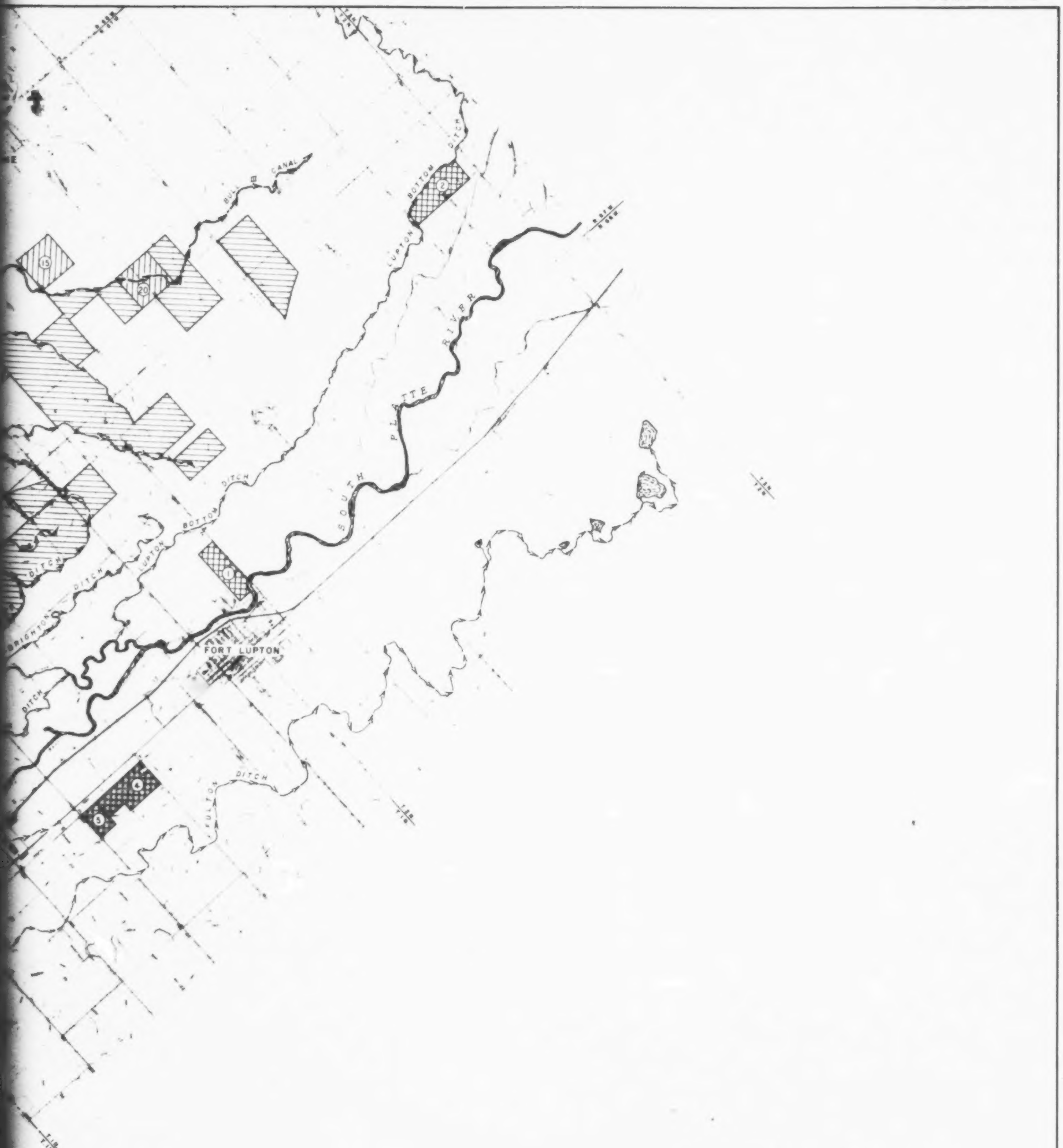
FIGURE A-2


BULL CANAL
LUPTON BOTTOM DITCH
SOUTH PLATTE RIVER
FORT LUPTON
BRIGHTON DITCH
FULTON DITCH
DITCH
15
20
2
1
4
5

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

LAND USE AND FACILITY MAP

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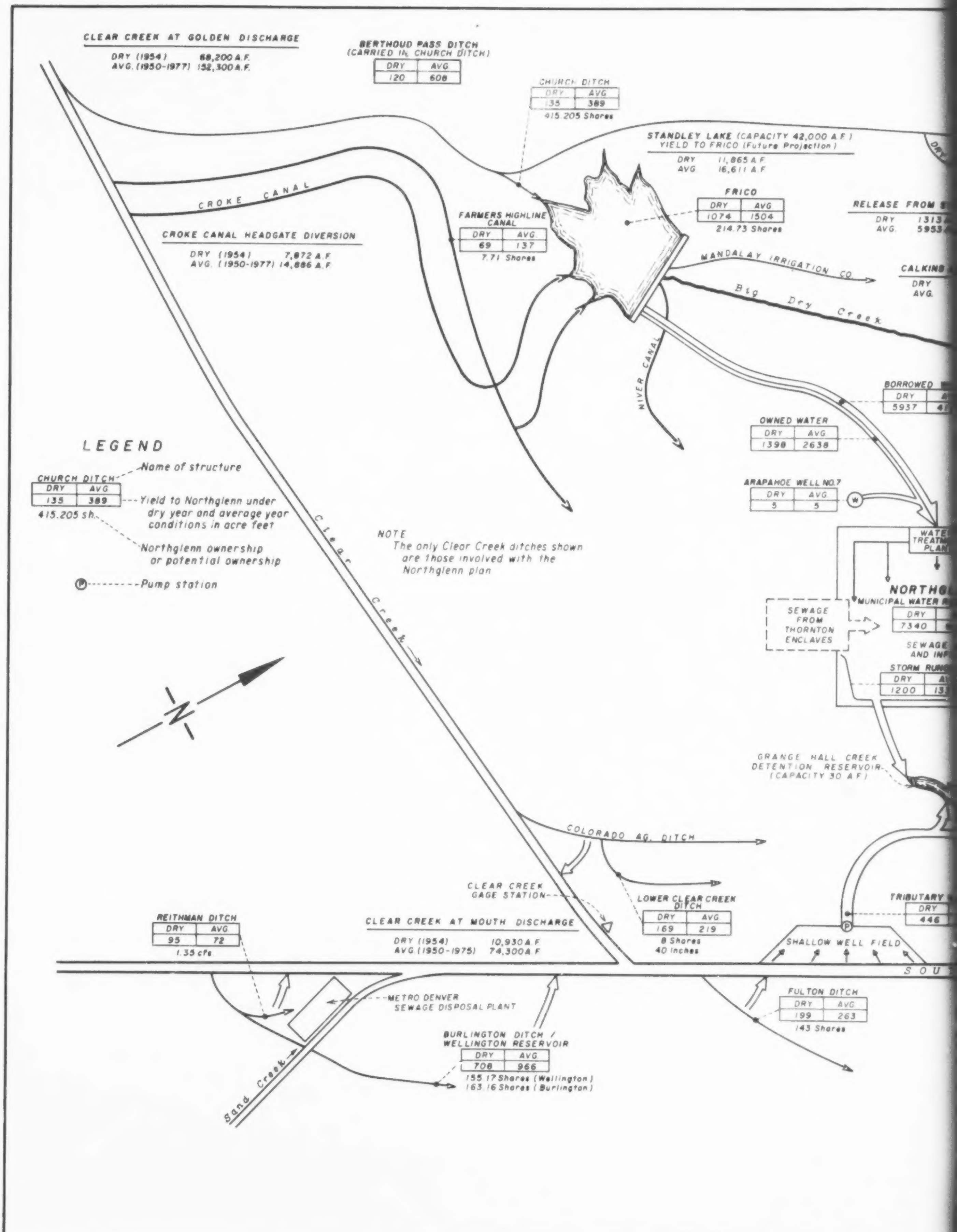
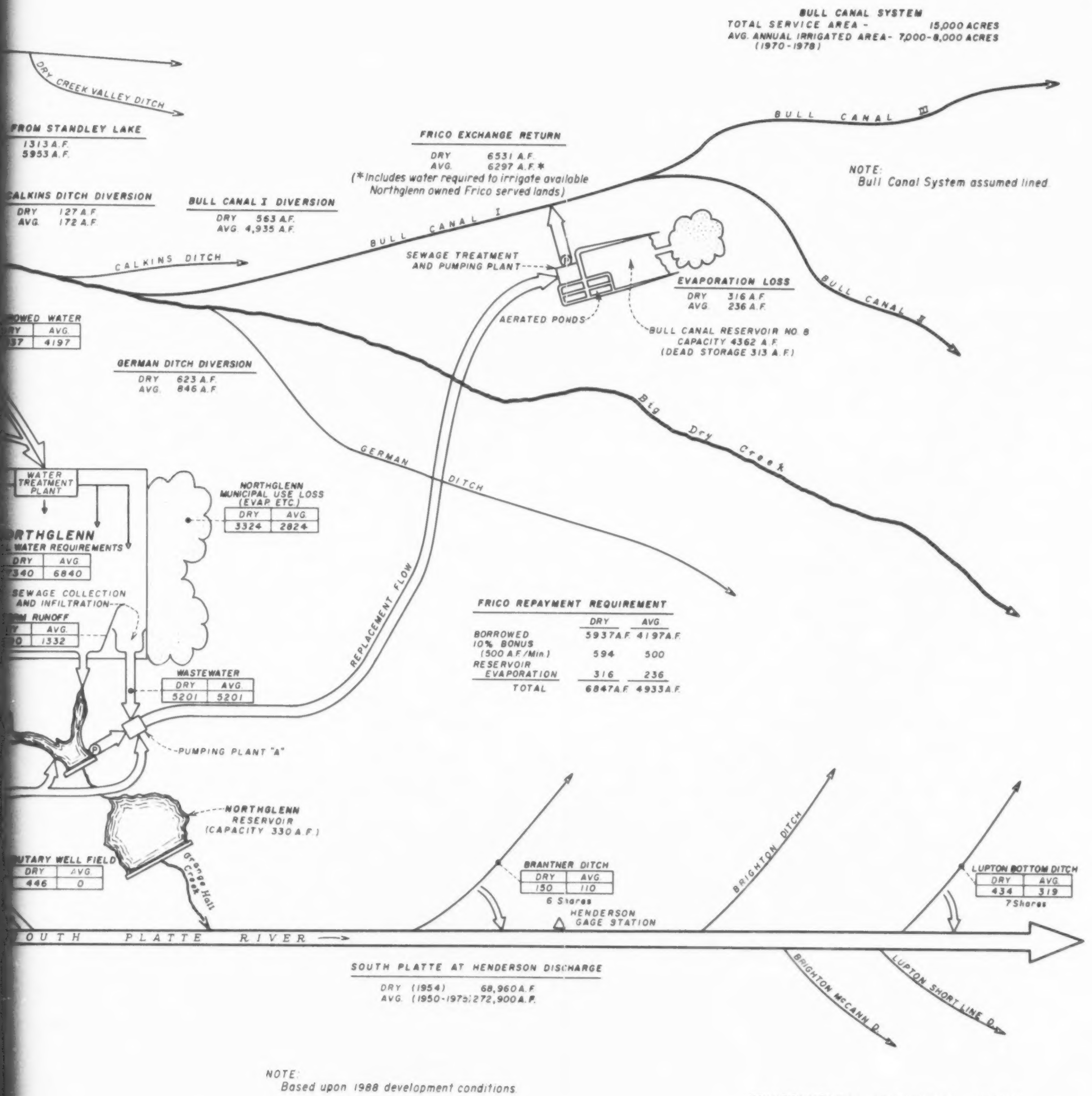
copy.


CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A.F.
AVG. (1950-1977) 152,300 A.F.
BERTHOUD PASS DITCH
(CARRIED IN CHURCH DITCH)
DRY AVG
120 608
CHURCH DITCH
DRY AVG
135 389
415.205 Shares
STANDLEY LAKE (CAPACITY 42,000 A.F.)
YIELD TO FRICO (Future Projection)
DRY 11,865 A.F.
AVG 16,611 A.F.
DRY
FRICO
DRY AVG
1074 1504
214.73 Shares
RELEASE FROM S
DRY 1313
AVG. 5953
CROKE CANAL
FARMERS HIGHLINE CANAL
DRY AVG
69 137
7.71 Shares
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A.F.
AVG. (1950-1977) 14,886 A.F.
MANDALAY IRRIGATION CO.
CALKINS
DRY
AVG.
Big Dry Creek
NIVER CANAL
BORROWED
DRY
5937
OWNED WATER
DRY AVG
1398 2638
LEGEND
CHURCH DITCH — Name of structure
DRY AVG
135 389 — Yield to Northglenn under dry year and average year conditions in acre feet
415.205 sh. — Northglenn ownership or potential ownership
P — Pump station
ARAPAHOE WELL NO.7
DRY AVG
5 5
W
WATE TREATM PLAN
NORTHG
MUNICIPAL WATER
DRY
7340
SEWAGE FROM THORNTON ENCLAVES
SEWAGE AND INF
STORM RUN
DRY
1200
NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan
Clear Creek
N
GRANGE HALL CREEK DETENTION RESERVOIR (CAPACITY 30 A.F.)
COLORADO AG. DITCH
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
DRY AVG
169 219
8 Shares
40 Inches
TRIBUTARY
DRY
446
P
SHALLOW WELL FIELD
REITHMAN DITCH
DRY AVG
95 72
1.35 cfs
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A.F.
AVG. (1950-1975) 74,300 A.F.
SOU
METRO DENVER SEWAGE DISPOSAL PLANT
FULTON DITCH
DRY AVG
199 263
143 Shares
BURLINGTON DITCH / WELLINGTON RESERVOIR
DRY AVG
708 966
155.17 Shares (Wellington)
163.16 Shares (Burlington)
Sand Creek


BULL CANAL SYSTEM
TOTAL SERVICE AREA - 15,000 ACRES
AVG. ANNUAL IRRIGATED AREA - 7,000-8,000 ACRES (1970-1978)
DRY CREEK VALLEY DITCH
FROM STANDLEY LAKE
1313 A.F.
5953 A.F.
FRICO EXCHANGE RETURN
DRY 6531 A.F.
AVG. 6297 A.F.*
(*Includes water required to irrigate available Northglenn owned Frico served lands)
BULL CANAL III
NOTE: Bull Canal System assumed lined.
CALKINS DITCH DIVERSION
DRY 127 A.F.
AVG. 172 A.F.
BULL CANAL I DIVERSION
DRY 563 A.F.
AVG. 4,935 A.F.
BULL CANAL I
CALKINS DITCH
SEWAGE TREATMENT AND PUMPING PLANT
EVAPORATION LOSS
DRY 316 A.F.
AVG. 236 A.F.
BULL CANAL II
ROWED WATER
RY | AVG.
37 | 4197
AERATED PONDS
BULL CANAL RESERVOIR NO. 8
CAPACITY 4362 A.F.
(DEAD STORAGE 313 A.F.)
GERMAN DITCH DIVERSION
DRY 623 A.F.
AVG. 846 A.F.
Big Dry Creek
GERMAN DITCH
WATER TREATMENT PLANT
NORTHGLENN MUNICIPAL USE LOSS (EVAP. ETC.)
DRY | AVG.
3324 | 2824
RTHGLENN
L WATER REQUIREMENTS
DRY | AVG.
7340 | 6840
SEWAGE COLLECTION AND INFILTRATION
RM RUNOFF
RY | AVG.
90 | 1332
REPLACEMENT FLOW
FRICO REPAYMENT REQUIREMENT
DRY | AVG
BORROWED 5937 A.F. | 4197 A.F.
10% BONUS (500 A.F./Min.) 594 | 500
RESERVOIR EVAPORATION 316 | 236
TOTAL 6847 A.F. | 4933 A.F.
WASTEWATER
DRY | AVG.
5201 | 5201
PUMPING PLANT "A"
NORTHGLENN RESERVOIR (CAPACITY 330 A.F.)
UTARY WELL FIELD
DRY | AVG.
446 | 0
Orange Hall Creek
BRANTNER DITCH
DRY | AVG.
150 | 110
6 Shares
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY | AVG.
434 | 319
7 Shares
HENDERSON GAGE STATION
OUTH PLATTE RIVER →
BRIGHTON McCANN D.
LUPTON SHORT LINE D.
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A.F.
AVG. (1950-1975) 272,900 A.F.
NOTE: Based upon 1988 development conditions.

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 1
(WITHOUT DEEP WELLS)

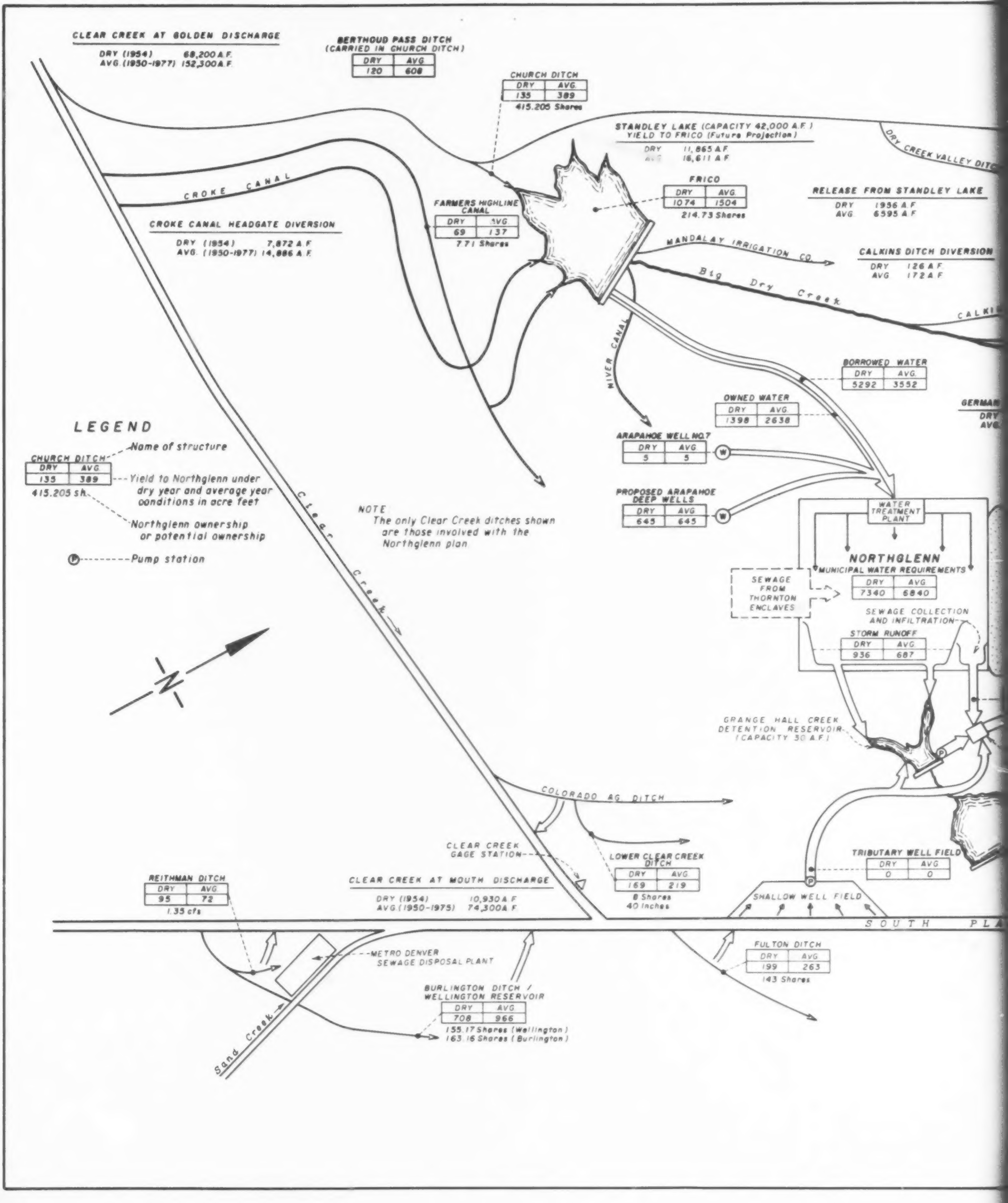
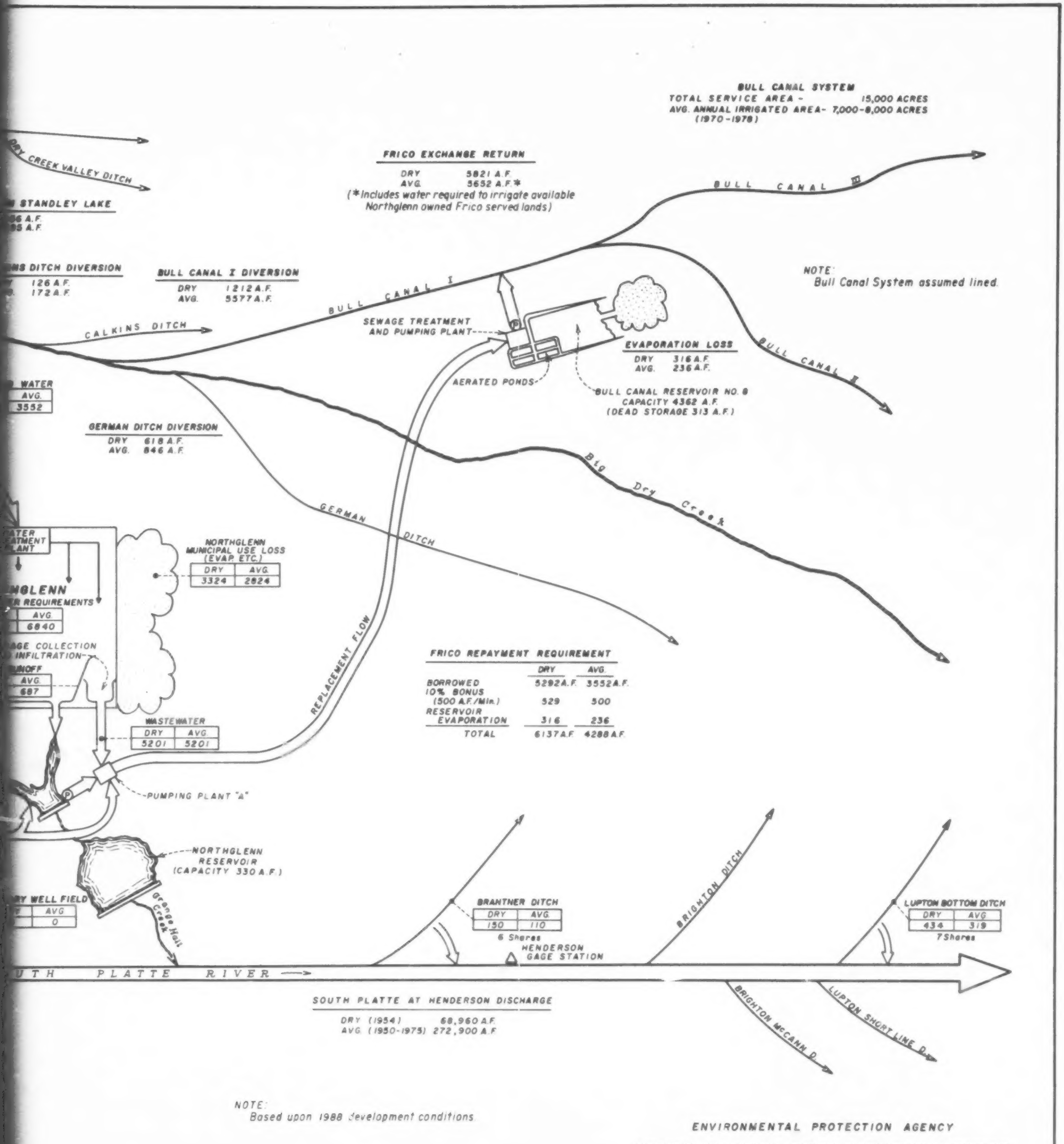

CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A.F.
AVG. (1950-1977) 152,300 A.F.
BERTHOUD PASS DITCH (CARRIED IN CHURCH DITCH)
DRY 120 AVG 608
CHURCH DITCH
DRY 135 AVG. 389
415.205 Shares
STANDLEY LAKE (CAPACITY 42,000 A.F.) YIELD TO FRICO (Future Projection)
DRY 11,865 A.F.
AVG 16,611 A.F.
DRY CREEK VALLEY DITC
CROKE CANAL
FARMERS HIGHLINE CANAL
DRY 69 AVG 137
7.71 Shares
FRICO
DRY 1074 AVG. 1504
214.73 Shares
RELEASE FROM STANDLEY LAKE
DRY 1936 A.F.
AVG. 6595 A.F.
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A.F.
AVG. (1950-1977) 14,886 A.F.
MANDALAY IRRIGATION CO.
CALKINS DITCH DIVERSION
DRY 126 A.F.
AVG 172 A.F.
Big Dry Creek
CALKI
NIVER CANAL
BORROWED WATER
DRY 5292 AVG. 3552
GERMAN
DRY
AVG
OWNED WATER
DRY 1398 AVG. 2638
LEGEND
CHURCH DITCH — Name of structure
DRY 135 AVG. 389 — Yield to Northglenn under dry year and average year conditions in acre feet
415.205 sh. — Northglenn ownership or potential ownership
P — Pump station
ARAPAHOE WELL NO.7
DRY 5 AVG. 5
W
PROPOSED ARAPAHOE DEEP WELLS
DRY 645 AVG 645
W
NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan
Clear Creek
N
WATER TREATMENT PLANT
NORTHGLENN
MUNICIPAL WATER REQUIREMENTS
DRY 7340 AVG 6840
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECTION AND INFILTRATION
STORM RUNOFF
DRY 936 AVG. 687
GRANGE HALL CREEK DETENTION RESERVOIR (CAPACITY 30 A.F.)
P
COLORADO AG DITCH
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
DRY 169 AVG 219
8 Shares
40 Inches
TRIBUTARY WELL FIELD
DRY 0 AVG 0
REITHMAN DITCH
DRY 95 AVG. 72
1.35 cfs
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A.F.
AVG. (1950-1975) 74,300 A.F.
P
SHALLOW WELL FIELD
SOUTH PLA
METRO DENVER SEWAGE DISPOSAL PLANT
FULTON DITCH
DRY 199 AVG 263
143 Shares
BURLINGTON DITCH / WELLINGTON RESERVOIR
DRY 708 AVG. 966
155.17 Shares (Wellington)
163.16 Shares (Burlington)
Sand Creek

FIGURE 3-3


BULL CANAL SYSTEM
TOTAL SERVICE AREA - 15,000 ACRES
AVG. ANNUAL IRRIGATED AREA - 7,000-8,000 ACRES (1970-1978)
DRY CREEK VALLEY DITCH
FRICO EXCHANGE RETURN
DRY 5821 A.F.
AVG. 5652 A.F.*
(*Includes water required to irrigate available Northglenn owned Frico served lands)
BULL CANAL III
STANDLEY LAKE
86 A.F.
85 A.F.
MS DITCH DIVERSION
Y 126 A.F.
G. 172 A.F.
BULL CANAL I DIVERSION
DRY 1212 A.F.
AVG. 5577 A.F.
BULL CANAL I
NOTE: Bull Canal System assumed lined.
CALKINS DITCH
SEWAGE TREATMENT AND PUMPING PLANT
EVAPORATION LOSS
DRY 316 A.F.
AVG. 236 A.F.
BULL CANAL II
AERATED PONDS
BULL CANAL RESERVOIR NO. 8
CAPACITY 4362 A.F.
(DEAD STORAGE 313 A.F.)
WATER
AVG.
3552
GERMAN DITCH DIVERSION
DRY 618 A.F.
AVG. 846 A.F.
Big Dry Creek
GERMAN DITCH
ATER
ATMENT
LANT
NORTHGLENN MUNICIPAL USE LOSS (EVAP. ETC.)
DRY 3324
AVG. 2824
HGLENN
ER REQUIREMENTS
AVG. 6840
AGE COLLECTION
INFILTRATION
RUNOFF
AVG. 687
REPLACEMENT FLOW
WASTEWATER
DRY 5201
AVG. 5201
PUMPING PLANT "A"
NORTHGLENN RESERVOIR (CAPACITY 330 A.F.)
RY WELL FIELD
AVG. 0
Grange Hall Creek
BRANTNER DITCH
DRY 150
AVG. 110
6 Shares
HENDERSON GAGE STATION
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY 434
AVG 319
7 Shares
UTH PLATTE RIVER
BRIGHTON McCANN D.
LUPTON SHORT LINE D.

FRICO REPAYMENT REQUIREMENT

	DRY	AVG.
BORROWED	5292 A.F.	3552 A.F.
10% BONUS (500 A.F./Min.)	529	500
RESERVOIR EVAPORATION	316	236
TOTAL	6137 A.F.	4288 A.F.

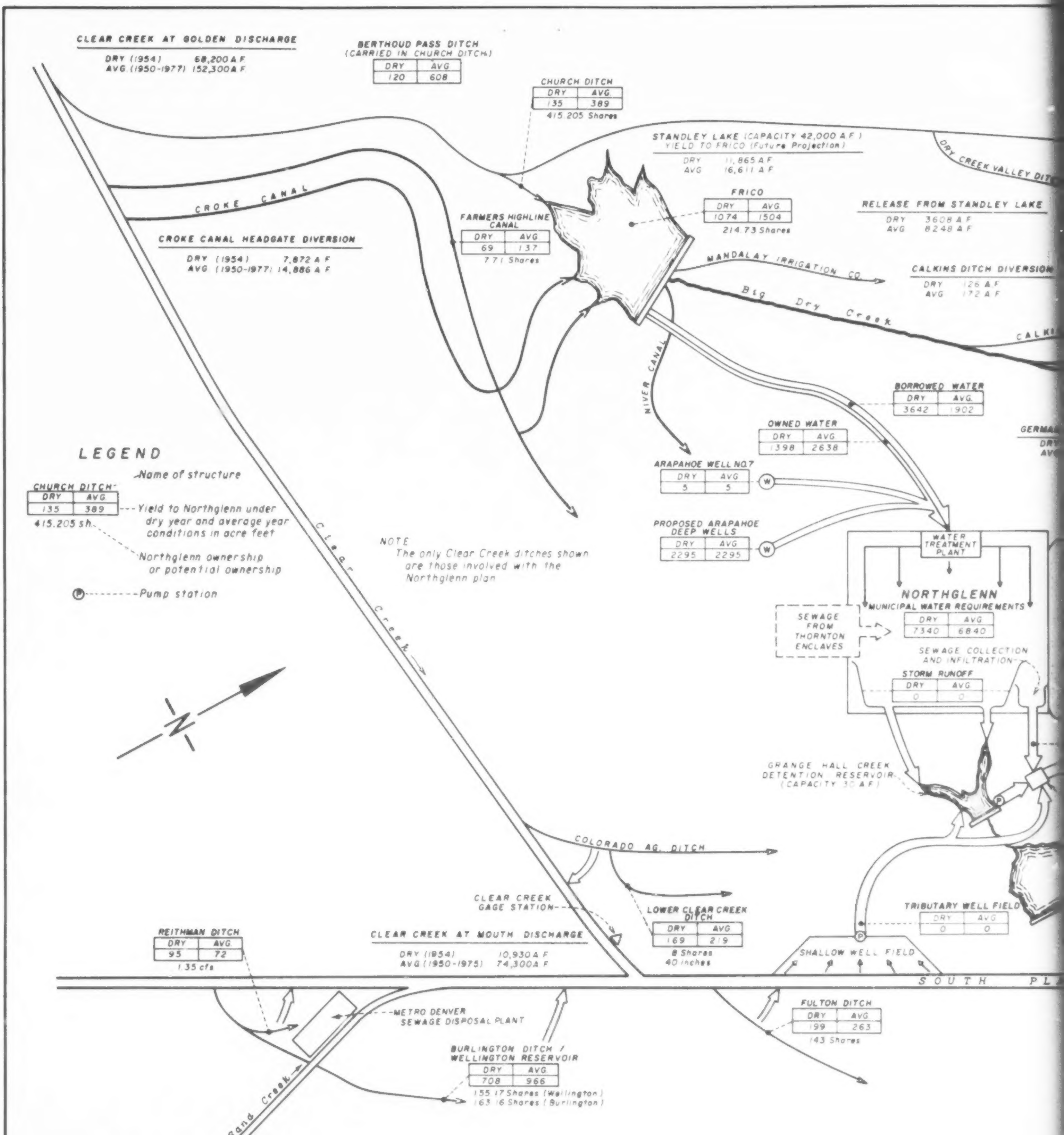
SOUTH PLATTE AT HENDERSON DISCHARGE

DRY (1954) 68,960 A.F.
AVG. (1950-1975) 272,900 A.F.

NOTE:
Based upon 1988 development conditions.

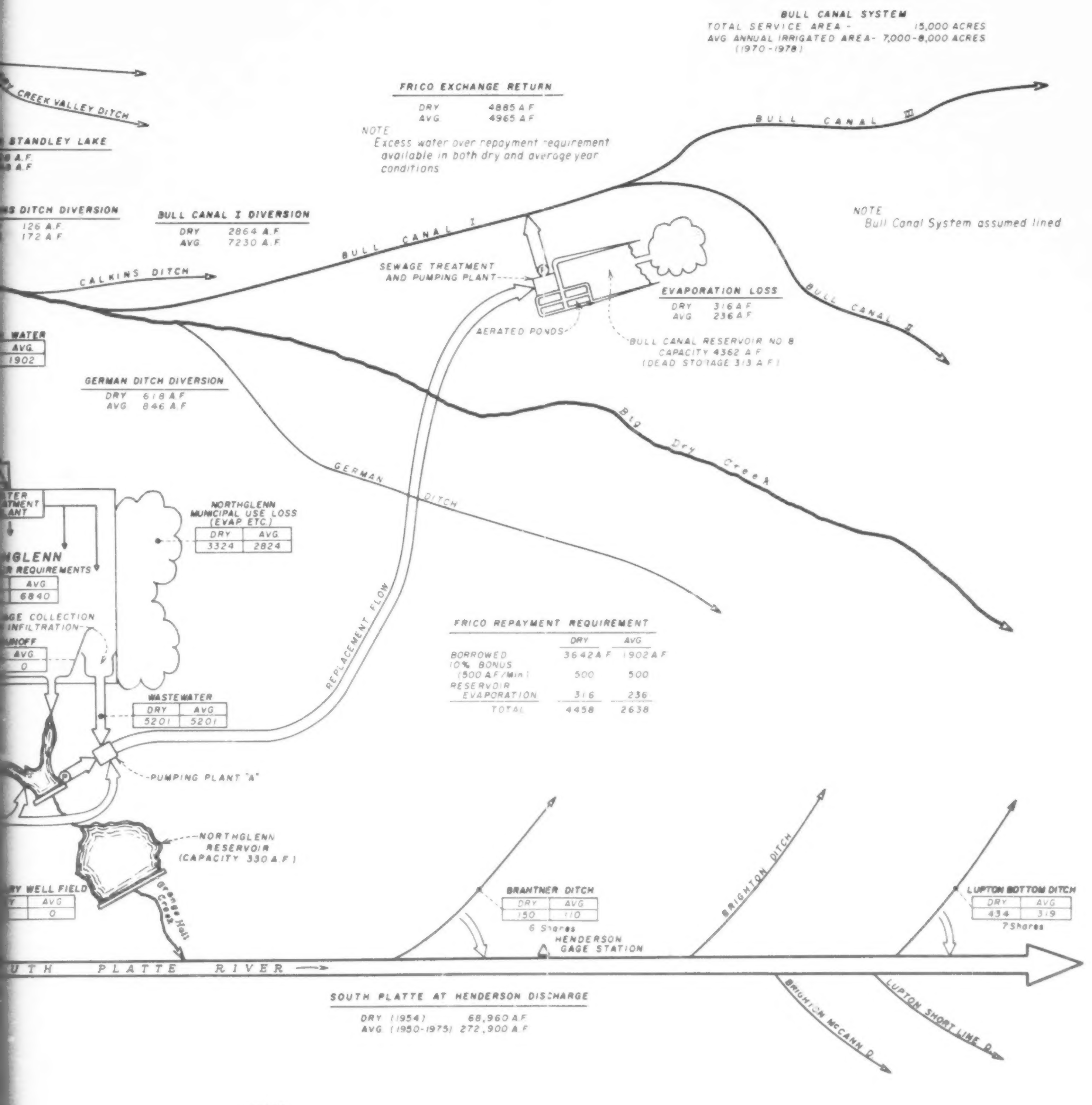
ENVIRONMENTAL PROTECTION AGENCY
NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 2
(650 A.F. FROM DEEP WELLS)


CLEAR CREEK AT GOLDEN DISCHARGE
DRY (1954) 68,200 A.F.
AVG. (1950-1977) 152,300 A.F.
BERTHOUD PASS DITCH
(CARRIED IN CHURCH DITCH)
DRY | AVG
120 | 608
CHURCH DITCH
DRY | AVG.
135 | 389
415.205 Shares
STANDLEY LAKE (CAPACITY 42,000 A.F.)
YIELD TO FRICO (Future Projection)
DRY 11,865 A.F.
AVG 16,611 A.F.
DRY CREEK VALLEY DITC
CROKE CANAL
FARMERS HIGHLINE CANAL
DRY | AVG
69 | 137
771 Shares
FRICO
DRY | AVG
1074 | 1504
214.73 Shares
RELEASE FROM STANDLEY LAKE
DRY 3608 A.F.
AVG 8248 A.F.
CROKE CANAL HEADGATE DIVERSION
DRY (1954) 7,872 A.F.
AVG. (1950-1977) 14,886 A.F.
MANDALAY IRRIGATION CO.
CALKINS DITCH DIVERSION
DRY 126 A.F.
AVG 172 A.F.
Big Dry Creek
CALKI
NIVER CANAL
BORROWED WATER
DRY | AVG.
3642 | 1902
GERMA
DRY
AV
OWNED WATER
DRY | AVG
1398 | 2638
ARAPAHOE WELL NO.7
DRY | AVG
5 | 5
W
PROPOSED ARAPAHOE DEEP WELLS
DRY | AVG
2295 | 2295
W
WATER TREATMENT PLANT
NORTHGLENN
MUNICIPAL WATER REQUIREMENTS
DRY | AVG
7340 | 6840
SEWAGE FROM THORNTON ENCLAVES
SEWAGE COLLECTION AND INFILTRATION
STORM RUNOFF
DRY | AVG
0 | 0
GRANGE HALL CREEK DETENTION RESERVOIR (CAPACITY 30 A.F.)
P
LEGEND
CHURCH DITCH
DRY | AVG
135 | 389
415.205 sh.
Name of structure
Yield to Northglenn under dry year and average year conditions in acre feet
Northglenn ownership or potential ownership
P
Pump station
N
Clear Creek
COLORADO AG. DITCH
CLEAR CREEK GAGE STATION
LOWER CLEAR CREEK DITCH
DRY | AVG
169 | 219
8 Shares
40 inches
TRIBUTARY WELL FIELD
DRY | AVG
0 | 0
P
SHALLOW WELL FIELD
REITHMAN DITCH
DRY | AVG.
95 | 72
1.35 cfs
CLEAR CREEK AT MOUTH DISCHARGE
DRY (1954) 10,930 A.F.
AVG. (1950-1975) 74,300 A.F.
SOUTH PL
METRO DENVER SEWAGE DISPOSAL PLANT
FULTON DITCH
DRY | AVG
199 | 263
143 Shares
BURLINGTON DITCH / WELLINGTON RESERVOIR
DRY | AVG
708 | 966
155.17 Shares (Wellington)
163.16 Shares (Burlington)
Sand Creek

NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan

FIGURE 3-4


BULL CANAL SYSTEM
TOTAL SERVICE AREA - 15,000 ACRES
AVG ANNUAL IRRIGATED AREA - 7,000-8,000 ACRES
(1970-1978)
FRICO EXCHANGE RETURN
DRY 4885 A.F.
AVG. 4965 A.F.
NOTE
Excess water over repayment requirement available in both dry and average year conditions
CREEK VALLEY DITCH
STANDLEY LAKE
A.F.
A.F.
S DITCH DIVERSION
126 A.F.
172 A.F.
BULL CANAL I DIVERSION
DRY 2864 A.F.
AVG. 7230 A.F.
BULL CANAL II
BULL CANAL I
NOTE
Bull Canal System assumed lined
CALKINS DITCH
SEWAGE TREATMENT AND PUMPING PLANT
EVAPORATION LOSS
DRY 316 A.F.
AVG. 236 A.F.
BULL CANAL II
AERATED PONDS
BULL CANAL RESERVOIR NO. 8
CAPACITY 4362 A.F.
(DEAD STORAGE 313 A.F.)
WATER
AVG.
1902
GERMAN DITCH DIVERSION
DRY 618 A.F.
AVG 846 A.F.
Big Dry Creek
GERMAN DITCH
TER
ATMENT
ANT
NORTHGLENN MUNICIPAL USE LOSS (EVAP. ETC.)
DRY 3324
AVG. 2824
GLENN
R REQUIREMENTS
AVG
6840
GE COLLECTION
INFILTRATION
NOFF
AVG
0
REPLACEMENT FLOW
WASTEWATER
DRY 5201
AVG 5201
PUMPING PLANT "A"
NORTHGLENN RESERVOIR (CAPACITY 330 A.F.)
RY WELL FIELD
AVG
0
Grange Hall Creek
BRANTNER DITCH
DRY 150
AVG 110
6 Shares
HENDERSON GAGE STATION
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY 434
AVG 319
7 Shares
UTH PLATTE RIVER
BRIGHTON McCANN D.
LUPTON SHORT LINE D.
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A.F.
AVG. (1950-1975) 272,900 A.F.

FRICO REPAYMENT REQUIREMENT

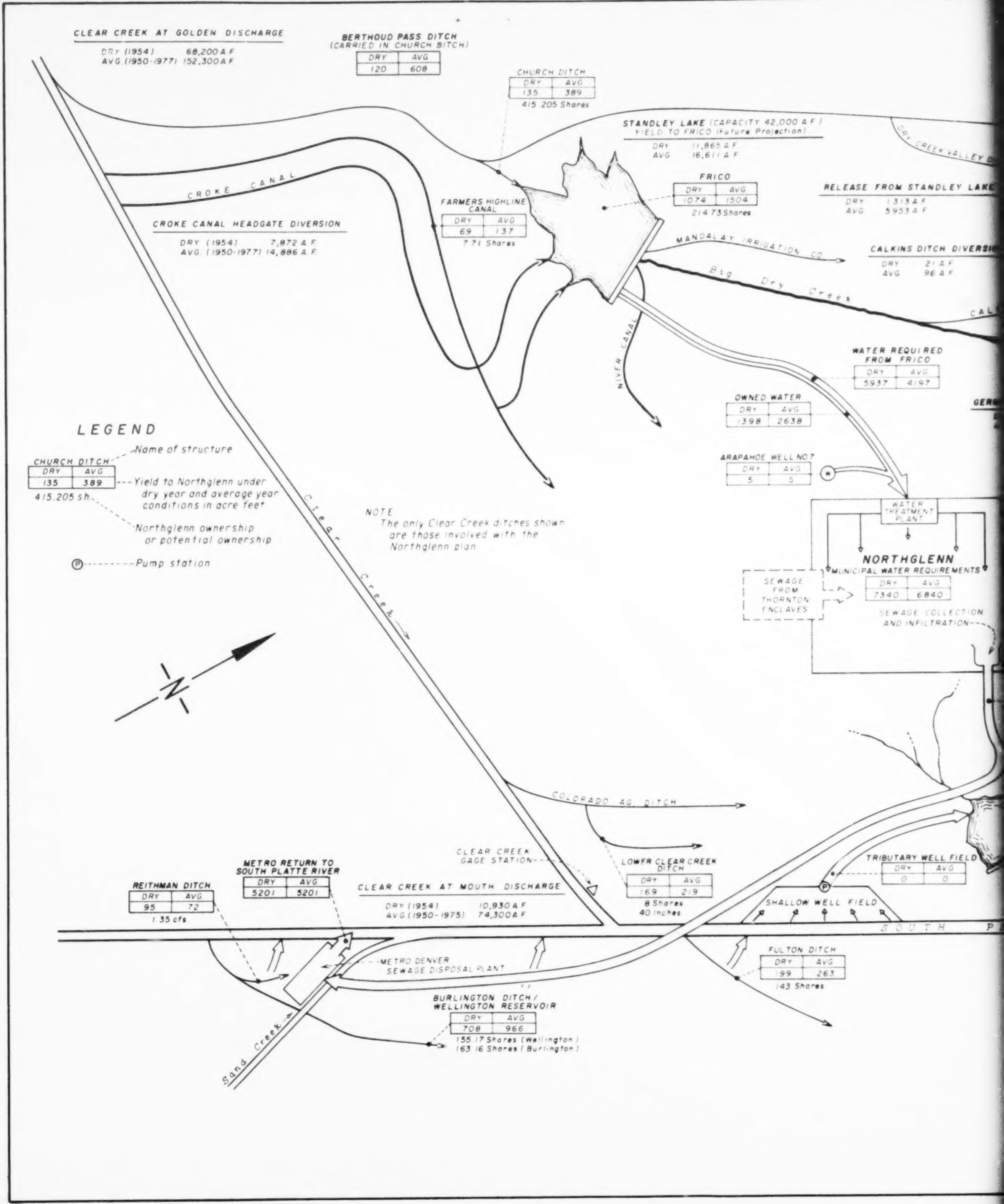
	DRY	AVG
BORROWED	3642 A.F.	1902 A.F.
10% BONUS (500 A.F./Min.)	500	500
RESERVOIR EVAPORATION	316	236
TOTAL	4458	2638

NOTES:
Based upon 1988 development conditions
Augmentation of replacement water not required under this option

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 3
(2300 A.F. FROM DEEP WELLS)



Croke Canal
Clear Creek
Farmers Highline Canal
Niver Canal
Mandalay Irrigation Co
Big Dry Creek
Dry Creek Valley D
CAL
GER
Water Treatment Plant
NORTHGLENN
Sewage from Thornton Enclaves
Sewage collection and infiltration
Colorado Ag Ditch
Clear Creek Gage Station
Shallow Well Field
South P
Metro Denver Sewage Disposal Plant
Sand Creek
N
LEGEND
Church Ditch — Name of structure
Yield to Northglenn under dry year and average year conditions in acre feet
415.205 sh. — Northglenn ownership or potential ownership
Ⓟ — Pump station

CLEAR CREEK AT GOLDEN DISCHARGE

DRY (1954) 68,200 A.F.
AVG (1950-1977) 152,300 A.F.

BERTHOUD PASS DITCH
(CARRIED IN CHURCH DITCH)

DRY	AVG
120	608

CHURCH DITCH

DRY	AVG
135	389

415.205 Shares

STANDLEY LAKE (CAPACITY 42,000 A.F.)
YIELD TO FRICO (Future Projection)

DRY 11,865 A.F.
AVG 16,611 A.F.

FRICO

DRY	AVG
1074	1504

214.73 Shares

RELEASE FROM STANDLEY LAKE

DRY 1313 A.F.
AVG 5953 A.F.

CALKINS DITCH DIVERSI

DRY 21 A.F.
AVG 96 A.F.

FARMERS HIGHLINE CANAL

DRY	AVG
69	137

7.71 Shares

CROKE CANAL HEADGATE DIVERSION

DRY (1954) 7,872 A.F.
AVG. (1950-1977) 14,886 A.F.

WATER REQUIRED FROM FRICO

DRY	AVG
5937	4197

OWNED WATER

DRY	AVG
1398	2638

ARAPAHOE WELL NO.7

DRY	AVG
5	5

MUNICIPAL WATER REQUIREMENTS

DRY	AVG
7340	6840

LEGEND

CHURCH DITCH

DRY	AVG
135	389

415.205 sh.

NOTE
The only Clear Creek ditches shown are those involved with the Northglenn plan.

TRIBUTARY WELL FIELD

DRY	AVG
0	0

LOWER CLEAR CREEK DITCH

DRY	AVG
169	219

8 Shares
40 Inches

CLEAR CREEK AT MOUTH DISCHARGE

DRY (1954) 10,930 A.F.
AVG (1950-1975) 74,300 A.F.

METRO RETURN TO SOUTH PLATTE RIVER

DRY	AVG
5201	5201

REITHMAN DITCH

DRY	AVG.
95	72

1.35 cfs

FULTON DITCH

DRY	AVG
199	263

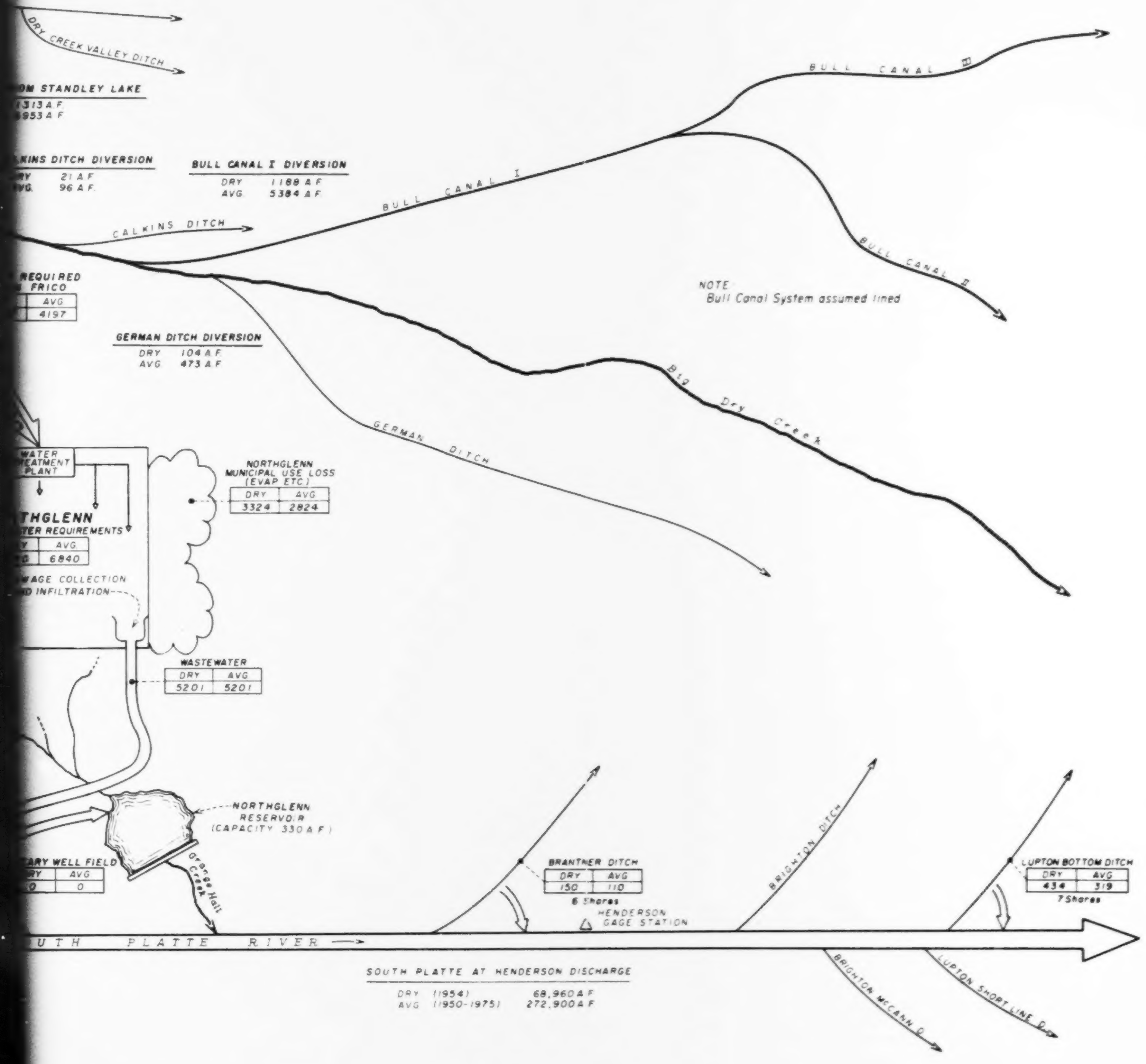
143 Shares

BURLINGTON DITCH / WELLINGTON RESERVOIR

DRY	AVG
708	966

155.17 Shares (Wellington)
163.16 Shares (Burlington)

FIGURE 3-5


DRY CREEK VALLEY DITCH
OM STANDLEY LAKE
1313 A.F.
6953 A.F.
KINS DITCH DIVERSION
RY 21 A.F.
VG. 96 A.F.
BULL CANAL I DIVERSION
DRY 1188 A.F.
AVG. 5384 A.F.
CALKINS DITCH
BULL CANAL I
BULL CANAL III
BULL CANAL II
NOTE
Bull Canal System assumed lined
REQUIRED
FRICO
AVG.
4197
GERMAN DITCH DIVERSION
DRY 104 A.F.
AVG. 473 A.F.
Big Dry Creek
GERMAN DITCH
WATER
TREATMENT
PLANT
NORTHGLENN
MUNICIPAL USE LOSS
(EVAP ETC.)
DRY 3324
AVG. 2824
THGLENN
TER REQUIREMENTS
AVG.
6840
WAGE COLLECTION
D INFILTRATION
WASTEWATER
DRY 5201
AVG 5201
NORTHGLENN
RESERVOIR
(CAPACITY 330 A.F.)
TARY WELL FIELD
RY
AVG
0
Grange Hall Creek
BRANTNER DITCH
DRY 150
AVG 110
6 Shares
HENDERSON
GAGE STATION
BRIGHTON DITCH
LUPTON BOTTOM DITCH
DRY 434
AVG 319
7 Shares
UTH PLATTE RIVER
BRIGHTON McCANN D.
LUPTON SHORT LINE D.
SOUTH PLATTE AT HENDERSON DISCHARGE
DRY (1954) 68,960 A.F.
AVG (1950-1975) 272,900 A.F.

NOTES

Based upon 1988 development conditions

Augmentation of replacement water not required under this option.

ENVIRONMENTAL PROTECTION AGENCY

NORTHGLENN/FRICO WATER MANAGEMENT PROGRAM

OPTION NO. 4
(RETURN TO METRO)

265.